# DRAFT

# RCRA Facility Investigation – Remedial Investigation/ Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site Appendix A – Comprehensive Risk Assessment

## Volume 10 of 15

## Risk Assessment for the Upper Woman Drainage Exposure Unit

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| µg/kg | micrograms per kilogram |
| µg/L | micrograms per liter |
| AI | adequate intake |
| AL | action level |
| AUF | area use factor |
| BAF | bioaccumulation factor |
| bgs | below ground surface |
| BW | body weight |
| BZ | Buffer Zone |
| CAD/ROD | Corrective Action Decision/Record of Decision |
| CDH | Colorado Department of Health |
| CDPHE | Colorado Department of Public Health and Environment |
| cfs | cubic feet per second |
| CNHP | Colorado Natural Heritage Program |
| COC | contaminant of concern |
| CRA | Comprehensive Risk Assessment |
| CSF | cancer slope factor |
| DOE | U.S. Department of Energy |
| DQA | Data Quality Assessment |
| DQO | data quality objective |
| DRI | dietary reference intake |
| ECOI | ecological contaminant of interest |
| ECOPC | ecological contaminant of potential concern |
| EcoSSL | Ecological Soil Screening Level |

| | |
|---|---|
| EPA | U.S. Environmental Protection Agency |
| EPC | exposure point concentration |
| ERA | Ecological Risk Assessment |
| ESL | ecological screening level |
| EU | Exposure Unit |
| HHRA | Human Health Risk Assessment |
| HQ | hazard quotient |
| HRR | Historical Release Report |
| IA | Industrial Area |
| IAEU | Industrial Area Exposure Unit |
| IAG | Interagency Agreement |
| IDEU | Inter-Drainage Exposure Unit |
| IHSS | Individual Hazardous Substance Site |
| kg | kilogram |
| K-H | Kaiser-Hill Company, L.L.C. |
| LOAEL | lowest observed adverse effect level |
| LOEC | lowest observed effect concentration |
| $L_{og}$ $K_{ow}$ | log octanol-water portioning coefficient |
| MDC | maximum detected concentration |
| mg | milligram |
| mg/day | milligrams per day |
| mg/kg | milligrams per kilogram |
| mg/kg/BW/day | milligrams per kilogram receptor body weight per day |
| mg/L | milligrams per liter |
| mL | milliliter |

| | |
|---|---|
| mL/day | milliliters per day |
| N/A | not applicable |
| NFAA | No Further Accelerated Action |
| NNEU | No Name Gulch Drainage Exposure Unit |
| NOAEL | no observed adverse effect level |
| NOEC | no observed effect concentration |
| OU | Operable Unit |
| PAC | Potential Area of Concern |
| PAH | polynuclear aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| pCi | picocurie |
| pCi/g | picocuries per gram |
| pCi/L | picocuries per liter |
| PCOC | potential contaminant of concern |
| PMJM | Preble's meadow jumping mouse |
| PRG | preliminary remediation goal |
| QAPjP | Quality Assurance Project Plan |
| RCRA | Resource Conservation and Recovery Act |
| RDA | recommended daily allowance |
| RDI | recommended daily intake |
| RFCA | Rocky Flats Cleanup Agreement |
| RfD | reference dose |
| RFETS | Rocky Flats Environmental Technology Site |
| RI/FS | Remedial Investigation/Feasibility Study |
| SAP | Sampling and Analysis Plan |

| | |
|---|---|
| SCM | site conceptual model |
| TCDD | 2,3,7,8-tetrachorodibenzo-p-dioxin |
| TEQ | toxic equivalent |
| tESL | threshold ecological screening level |
| TRV | toxicity reference value |
| UBC | Under Building Contamination |
| UCL | upper confidence limit |
| UL | upper limit (daily intake) |
| USFWS | U.S. Fish and Wildlife Service |
| UT | uncertain toxicity |
| UTL | upper tolerance limit |
| UWOEU | Upper Woman Drainage Exposure Unit |
| WRV | wildlife refuge visitor |
| WRW | wildlife refuge worker |

# EXECUTIVE SUMMARY

This report presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the 524-acre Upper Woman Drainage Exposure Unit (EU) (UWOEU) at the Rocky Flats Environmental Technology Site (RFETS). The purpose of this report is to assess risks to human health and ecological receptors posed by exposure to contaminants of concern (COCs) and ecological contaminants of potential concern (ECOPCs) remaining at the UWOEU after completion of accelerated actions at RFETS.

Benzo(a)pyrene and dioxins/furans were the only COCs selected for surface soil/surface sediment in the UWOEU. Dioxin/furan concentrations were converted to 2,3,7,8-tetrachorodibenzo-p-dioxin (TCDD) Toxicity Equivalents (TEQs) for COC screening and risk characterization. Although benzo(a)pyrene was selected as a COC and was evaluated quantitatively in the HHRA, it has not necessarily been directly associated with historical Individual Hazardous Substance Sites (IHSSs) in the UWOEU, but could be associated with traffic, pavement degradation, or pavement operations in the UWOEU and the nearby Industrial Area EU (IAEU). No COCs were selected for subsurface soil/sediment.

Noncancer risks for benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) were not evaluated because those COCs do not have noncancer toxicity values. Risks were calculated for benzo(a)pyrene and 2,3,7,8 TCDD (TEQ). The estimated Tier 1 total excess lifetime cancer risk to the WRW at the UWOEU is 8E-06, and the Tier 2 risk is 3E-06. The estimated Tier 1 risks are mostly (73 percent) from benzo(a)pyrene, and are greatly impacted by two samples with unusually high benzo(a)pyrene concentrations that are located underneath the cover of the Original Landfill. Because exposure to soil at these location is not anticipated, the benzo(a)pyrene concentration estimate for the UWOEU and the associated risk are likely overestimated. The excess lifetime cancer risk for the WRW in the UWOEU is within U.S. Environmental Protection Agency (EPA) acceptable risk range (i.e., within or below a 1E-04 to 1E-06).

As part of the uncertainty analysis, the UCL was calculated for benzo(a)pyrene using only samples in the UWOEU that are located outside the Original Landfill cover. This UCL is less than the PRG, therefore, benzo(a)pyrene would not be identified as a COC for the portion of UWOEU that is outside the Original Landfill cover. Accordingly, risks associated with exposure to benzo(a)pyrene in the UWOEU in areas outside the Original Landfill cover are less than 1E-06.

Exposure to the 2,3,7,8 TCDD (TEQ) in soil is also not anticipated because these samples are located approximately 20 feet below ground surface (bgs). These samples were taken as confirmation samples in an excavation following and accelerated action and, therefore, were classified as surface soil samples. However, the locations are actually approximately 20 feet bgs and not accessible by the WRW or WRV.

In the ERA, ECOPCs in surface soil were identified for non-Preble's jumping mouse (PMJM) and PMJM receptors. ECOPCs for selected populations of non-PMJM receptors included antimony, copper, nickel, silver, tin, uranium, vanadium, bis(2-

ethylhexyl)phthalate, di-n-butylphthalate, 2,3,7,8-TCDD (TEQ) and total polychlorinated biphenyls (PCBs). ECOPCs for individual PMJM receptors included antimony, chromium, copper, manganese, molybdenum, nickel, tin, vanadium, zinc, and total PCBs. No ECOPCs were identified in subsurface soil. The ECOPC/receptor pairs were evaluated in the risk characterization using a range of EPCs, exposure scenarios, and toxicity reference values (TRVs) to give a range of risk estimates.

Overall, no significant risks to ecological receptors that may use the UWOEU are predicted. In addition, the high species diversity and continued use of the site by numerous vertebrate species verify that habitat quality for these species remains acceptable and the ecosystem functions are being maintained. Data collected on wildlife abundance and diversity indicate that wildlife populations are stable and species richness remains high during remediation activities at RFETS, including wildlife using the UWOEU. Overall, no significant risk to survival, growth, and reproduction is predicted for the ecological receptors evaluated in the UWOEU.

# 1.0 INTRODUCTION

This volume of the Comprehensive Risk Assessment (CRA) presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the Upper Woman Drainage Exposure Unit (EU) (UWOEU) at the Rocky Flats Environmental Technology Site (RFETS) (Figure 1.1).

The anticipated future land use of RFETS is a wildlife refuge. Consequently, two human receptors, a wildlife refuge worker (WRW) and a wildlife refuge visitor (WRV), are evaluated in this risk assessment consistent with this land use. A variety of representative terrestrial and aquatic receptors are evaluated in the ERA including the Preble's meadow jumping mouse (PMJM), a federally listed threatened species present at RFETS. The HHRA and ERA methods and selection of receptors are described in detail in the approved Final CRA Work Plan and Methodology Revision 1 (U.S. Department of Energy [DOE] 2005a) (hereafter referred to as the CRA Methodology).

## 1.1 Upper Woman Drainage Exposure Unit Description

This section provides a brief description of the UWOEU, including its location at RFETS, historical activities in the area, topography, surface water features, vegetation, and ecological resources. A more detailed description of these features and additional information regarding the geology, hydrology, and soil types at RFETS is included in Section 2.0, Physical Characteristics of the Study Area contained in the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report).

The 2005 Annual update to the Historical Release Report (HRR) (DOE 2005b) provides descriptions of known or suspected releases of hazardous substances that occurred at RFETS. The original HRR (DOE 1992a) organized these known or suspected historical sources of contamination as Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), or Under Building Contamination (UBC) sites (hereafter collectively referred to as historical IHSSs). Individual historical IHSSs and groups of historical IHSSs were also designated as Operable Units (OUs). Over the course of cleanup under the 1991 Interagency Agreement (IAG) and the 1996 Rocky Flats Cleanup Agreement (RFCA), the DOE has thoroughly investigated and characterized contamination associated with these historical IHSSs. Historical IHSSs have been dispositioned through appropriate remedial actions or by determining that No Further Accelerated Action (NFAA) is required, pursuant to the applicable IAG and RFCA requirements. Some OUs have also been dispositioned in accordance with an OU-specific Corrective Action Decision/Record of Decision (CAD/ROD).

A more detailed description of the regulatory agreements and the investigation and cleanup history under these agreements is contained in Section 1.0 of the RI/FS Report. Section 1.4.3 of the report describes the accelerated action process, while the disposition of all historical IHSSs at RFETS is summarized in Table 1.4. The 2005 Annual Update to the HRR (DOE 2005b) provides a description of the potential contaminant releases for each IHSS and any interim response to the releases; identification of potential contaminants based on process knowledge and site data; data collection activities; accelerated action activities (if any); and the basis for recommending no further accelerated action.

Several historical IHSSs exist within the UWOEU (Table 1.1 and Figure 1.2) and all have received regulatory agency-approved No Further Actions (NFAs) or NFAAs. This is documented in the Annual Updates to the HRR as noted in Table 1.1.

### 1.1.1 Exposure Unit Characteristics and Location

The UWOEU comprises 524 acres in the southwestern portion of RFETS (Figure 1.1) and contains several distinguishing features:

- The UWOEU is located within the Buffer Zone (BZ) OU immediately south of areas that were used historically for operation of RFETS (the Industrial Area [IA]).

- The UWOEU includes much of Upper Woman Creek and three named tributaries of Upper Woman Creek: Owl Branch, Antelope Creek, and Hideout Draw.

- The South Interceptor Ditch (SID) is a lateral ditch that traverses the hillside south of the IA and parallels Woman Creek on the uphill side. The SID effectively captures all runoff from the IA that would otherwise flow into Woman Creek.

- Potential historical sources within the UWOEU include the Original Landfill (PAC SW-115), the Ash Pits (PACs SW-133.1 through SW-133.4, SW-1701, and SW-1702), and the incinerator facility (IHSS 133.5).

The UWOEU is bounded by the Inter-Drainage EU (IDEU) and Industrial Area EU (IAEU) to the north, the Lower Woman Drainage EU (LWOEU) on the east, and the Southwest BZ Area EU (SWEU) to the south. The property west of the UWOEU is an agricultural parcel managed by the Colorado State Land Board to provide income in support of public education.

### 1.1.2 Topography and Surface Water Hydrology

As shown on a recent aerial photograph of the UWOEU (Figure 1.3), the UWOEU is the dissected edge of an alluvial pediment that slopes gently to the east. The UWOEU includes the valleys of Upper Woman Creek and a number of its tributaries. Upper Woman Creek and Owl Branch originate west of RFETS and flow east into the UWOEU, where they converge. Farther downstream, Antelope Creek enters from the southwest, and the SID runs parallel to Woman Creek to the north. The SID was designed to intercept runoff flowing south from the IA toward Woman Creek and to segregate it from runoff originating in other areas of the Woman Creek drainage. From the UWOEU, the

SID continues downstream and discharges into Pond C-2, while Woman Creek flows into Pond C-1, and then is diverted around Pond C-2. The portion of the SID overlying the original landfill has been removed as part of the remediation of the original landfill.

### 1.1.3 Flora and Fauna

Vegetation in the UWOEU is predominantly grassland. The major components are mesic mixed grasslands and xeric tallgrass prairie (Figure 1.4). The mesic mixed grassland is comprised of western wheatgrass (Agropyron smithii), blue grama (Bouteloua gracilis), side-oats grama (Bouteloua curtipendula), prairie junegrass (Koeleria pyramidata), Canada bluegrass (Poa compressa), Kentucky bluegrass (Poa pratensis), green needlegrass (Stipa virigula), and little bluestem (Andropogon scoparius). The xeric tallgrass prairie is distinguished by the plant species big bluestem (Andropogon gerardii), little bluestem (Andropogon scoparius), Indian-grass (Sorghastrum nutans), prairie dropseed (Sporobolus heterolepis), and switchgrass (Panicum virgatum). Xeric grasslands within the EU occur on the gently sloping pediment areas, and mesic mixed grasslands are found on hillsides where drainage ways become more defined. Wet meadows, short marshlands, cattail marshlands, riparian shrublands and riparian woodlands are found along Woman Creek, Antelope Springs, and within small seep-springs.

Grasslands are important to wildlife and grassland conditions within the UWOEU are good but weeds and introduced grass species have degraded grasslands in some areas (PTI 1997b). A prescribed burn was conducted in April 2000 (Kaiser-Hill Company, L.L.C. [K-H] 2001) to reduce weed infestation and remove accumulated thatch in the xeric grasslands within the southwestern corner of the EU. Weed control, erosion control, and reclamation activities on going within the EU will continue to promote native grasslands at RFETS (Nelson 2005).

Numerous animal species have been observed at RFETS, and the more common ones are expected to be present in the UWOEU. Common large and medium-sized mammals likely to live at or frequent the UWOEU include mule deer (Odocoileus hemionus), coyote (Canis latrans), raccoon (Procyon lotor), and desert cottontail (Sylvilagus audubonii). The most common reptile observed at RFETS is the western prairie rattlesnake (Crotalis viridus). Common bird species include meadow lark (Sturnella neglecta), vesper sparrow (Pooecetes gramineus), and red-winged blackbird. The most common small mammal species include deer mice (Peromyscus maniculatus), meadow voles (Microtus pennsylvanicus), and Mexican woodrat (Neotoma mexicana).

More information on the plant communities and animal species that exist within RFETS is provided in Section 2.0 of the RI/FS Report.

### 1.1.4 Preble's Meadow Jumping Mouse Habitat within Upper Woman Exposure Unit

The UWOEU supports habitat for the federally protected PMJM (Zapus hudsonius preblei). The preferred habitat for the PMJM is the riparian corridors bordering streams, ponds, and wetlands at RFETS with an adjacent thin band of upland grasslands. PMJM habitat within the EU occurs along Woman Creek above the C-1 pond to the western border of RFETS. PMJM have been captured within UWOEU for over a decade (Ebasco 1992; DOE 1995; K-H 1998, 2001). Upper Woman Creek supports approximately 6.5 (±1) individuals per kilometer (km) of stream (K-H 2001). This equates to approximately 16 individuals in the EU.

In an effort to characterize habitat discontinuity and provide indications of varying habitat quality, sitewide PMJM habitat patches were developed. Figure 1.5 presents PMJM patches within UWOEU. Patches that cross-over into the Lower Woman Drainage EU are considered with LWOEU. PMJM patches aid in the evaluation of surface soil within PMJM habitat, giving a spatial understanding of areas that may be used by individual PMJM or subpopulations of PMJM. More detail on the methodology of creating sitewide PMJM habitat patches can be found in Volume 2 of Appendix A, Section 3.2 of the RI/FS Report.

PMJM habitat within the UWOEU was divided into three habitat patches, each containing habitat capable of supporting several PMJM. The patches vary in size and shape dependent on their location within the Woman Creek drainage and discontinuity or habitat quality of surrounding patches. PMJM have been found in each of these three patches. The following is a brief discussion of the three patches within the UWOEU (Figure 1.5) and the reasons they are considered distinct:

- Patch #19 – This patch contains habitat at the upper end of Woman Creek. The riparian zone is narrow and supports leadplant shrubs and a mixture of willow shrublands and riparian woodlands. Densities of PMJM are much less than patches further downstream. The upper end of the patch corresponds to the RFETS boundary. The lower end corresponds to the confluence of a second tributary to Woman Creek.

- Patch # 20A and 20B – This patch is a combination of habitat along Woman Creek (20A) and a seep area to the south (20B). These areas can be considered one unit based on the hydrological connection, as supporting wetlands bridge the gap between the two habitat areas (USFWS 2004). The upper boundary for this patch corresponds to the confluence of a second tributary to Woman Creek. This patch contains mature willow shrubs and few cottonwood trees. A diversion ditch bisects the patch that diverts Woman Creek away from the base of the old landfill. The lower boundary corresponds to a change in the maturity of riparian shrubs.

- Patch #21A, 21B, and 21C – This patch contains a series of leadplant riparian shrubs and riparian woodlands with adjacent short marsh and short upland shrubs. It is different from the vegetation found in adjacent patches and lacks contiguous willow shrubs. The patch is located at the confluence of Woman Creek and Antelope Springs. An adjacent, but distinct, area of snowberry is part of this patch based on the hydrological connection of supporting wetlands (USFWS 2004).

### 1.1.5 Data Description

Data have been collected at RFETS under regulatory agency-approved Work Plans, Sampling and Analysis Plans (SAPs), and Quality Assurance Project Plans (QAPjPs) to meet data quality objectives (DQOs) and appropriate U.S. Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE) guidance. Surface soil, subsurface soil, sediment, surface water, and groundwater samples were collected from the UWOEU. Surface soil/surface sediment, subsurface soil/subsurface sediment, surface soil, and subsurface soil are the media evaluated in the HHRA and ERA (Table 1.2). The sampling locations for these media are shown on Figures 1.6 and 1.7, and data summaries for detected analytes in each medium are provided in Tables 1.3 through 1.7. Toxicity equivalence factors and toxicity equivalent concentrations for 2,3,7,8-tetrachorodibenzo-p-dioxin (TCDD) in surface soil/surface sediment, subsurface soil/subsurface sediment, and subsurface soil are presented in Tables 1.8, 1.9 and 1.10. Potential contaminants of concern (PCOCs) that were analyzed for but not detected are presented in Attachment 1. Detection limits are compared to preliminary remediation goals (PRGs) and ecological screening levels (ESLs), and discussed in Attachment 1 (Tables A1.1 through A1.4).

In accordance with the CRA Methodology, only data collected on or after June 28, 1991, and data for subsurface soil and subsurface sediment samples with a starting depth less than or equal to 8 feet below ground surface (bgs) are used in the CRA. Subsurface soil and subsurface sediment data are limited to this depth because it is not anticipated that the WRW or burrowing animals will dig to deeper depths. A detailed description of data storage and processing methods is provided in Appendix A, Volume 2 of the RI/FS Report. The CRA analytical data set for the UWOEU is provided on a compact disc presented in Attachment 6. The CD includes the data used in the CRA, as well as data not considered useable. Additional criteria for exclusion of data from use in the CRA are presented in Appendix A, Volume 2 of the RI/FS Report.

The sampling data used for the UWOEU HHRA and ERA are as follows:

- Combined surface soil/surface sediment data (HHRA);
- Combined subsurface soil/subsurface sediment data (HHRA);
- Surface soil data (ERA); and,
- Subsurface soil data (ERA).

The data for these media are briefly described below.

In addition, because ecological contaminants of potential concern (ECOPCs) were identified for soil in this EU, surface water data were used in the ERA as part of the overall intake of EOPCs by ecological receptor. The surface water data used in the ERA are summarized in Table 8.4. Surface water and sediment are assessed for ecological receptors on an Aquatic Exposure Unit (AEU) basis in Appendix A, Volume 15 of the RI/FS Report. An assessment of the surface water, groundwater-to-surface water, and volatilization pathways for human health are presented in Appendix A, Volume 2 of the RI/FS Report.

*Surface Soil/Surface Sediment*

The combined surface soil/surface sediment data set for the UWOEU consists of up to 217 samples that were analyzed for inorganics (166 samples), organics (148 samples), and radionuclides (217 samples) (Table 1.2). The data include sediment samples collected to depths down to 0.5 feet bgs. The samples were collected in the UWOEU between August 1991 and March 2005.

The sampling locations for surface soil and surface sediment are shown in Figure 1.6. The samples collected in 2004 were located on a 30-acre grid, as described in CRA SAP Addendum #04-01 (DOE 2004). For the grid sampling, five individual samples were collected and composited from each 30-acre cell, one from each quadrant and one in the center, as described in the CRA SAP Addendum #04-01 (DOE 2004). Most of the evenly spaced surface soil sampling locations in Figure 1.6 represent the 30-acre grid samples.

The data summary for detected analytes in surface soil/surface sediment for the UWOEU is presented in Table 1.3. Detected analytes included representatives from the inorganic, organic, and radionuclide analyte groups. A summary of analytes that were not detected in surface soil/surface sediment is presented and discussed in Attachment 1.

*Subsurface Soil/Subsurface Sediment*

The combined subsurface soil/subsurface sediment data set for the UWOEU consists of up to 298 samples analyzed for organics, 258 for inorganics, and 252 for radionuclides (Table 1.2). The data include subsurface sediment samples with a starting depth less than or equal to 8 feet bgs and an ending depth below 0.5 feet bgs. The subsurface soil/subsurface sediment samples were collected in the UWOEU between August 1991 to July 2004. The sampling locations for subsurface soil and subsurface sediment are shown in Figure 1.7.

The data summary for subsurface soil/subsurface sediment in the UWOEU is presented in Table 1.4. Detected analytes included representatives from the inorganic, organic, and radionuclide analyte groups. A summary of analytes that were not detected in subsurface soil/subsurface sediment is presented and discussed in Attachment 1.

*Surface Soil*

Data meeting the CRA requirements are available for up to 45 surface soil samples within PMJM habitat collected in the UWOEU that were analyzed for inorganics (35 samples), organics (28 samples), and radionuclides (45 samples) (Table 1.2). The surface soil sampling locations within PMJM habitat are shown in Figure 1.5. Data meeting the CRA requirements are available for up to 177 surface soil samples collected in the UWOEU that were analyzed for inorganics (135 samples), organics (121 samples), and radionuclides (177 samples) (Table 1.2). The surface soil sampling locations for the UWOEU are shown in Figure 1.6. Surface soil samples were collected in the UWOEU from August 1991 to August 2005.

The data summary for detected analytes in UWOEU surface soil is presented in Table 1.5, while the data summary for the detected analytes for those samples within designated PMJM habitat is presented in Table 1.6. Radionuclides, organics, and inorganics were all detected in UWOEU surface soil samples. A summary of analytes that were not detected in surface soil in the UWOEU is presented and discussed in Attachment 1.

***Subsurface Soil***

The subsurface soil data set for the UWOEU consists of up to 297 samples. All 297 samples were analyzed for organics, 257 for inorganics, and 251 for radionuclides (Table 1.2). Subsurface soil samples used in the CRA are defined in the CRA Methodology as soil samples with a starting depth less than or equal to 8 feet bgs and an ending depth below 0.5 feet bgs. The samples were collected in the UWOEU between August 1991 and July 2004. Subsurface soil sampling locations are shown in Figure 1.7.

The data summary for detected analytes in subsurface soil for the UWOEU is presented in Table 1.7. Subsurface soil samples were analyzed for inorganics, organics, and radionuclides, and representatives from all three analyte groups were detected. A summary of analytes that were not detected in subsurface soil is presented and discussed in Attachment 1.

## 1.2 Data Adequacy Assessment

A data adequacy assessment was performed to determine whether the available data set discussed in the previous section is adequate for risk assessment purposes. The data adequacy assessment rules are presented in the CRA Methodology, and a detailed data adequacy assessment for the data used in the CRA is presented in Appendix A, Volume 2 of the RI/FS Report. The adequacy of the data was assessed by examining the number of available samples for each analyte group in each medium for use in the CRA, the spatial and temporal representativeness of the data, as well as information on potential historical sources of contamination, migration pathways, and the concentration levels in the media. The assessment concludes that the data are adequate for the purposes of the CRA.

## 1.3 Data Quality Assessment

A Data Quality Assessment (DQA) of the UWOEU data was conducted to determine whether the data were of sufficient quality for risk assessment use. The DQA is presented in Attachment 2, and an evaluation of the entire RFETS data set is presented in Appendix A, Volume 2 of the RI/FS Report. The quality of the laboratory results were evaluated for compliance with the CRA Methodology DQOs through an overall review of precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. This review concluded that the data are of sufficient quality for use in the CRA, and the CRA DQOs have been met.

# 2.0 SELECTION OF HUMAN HEALTH CONTAMINANTS OF CONCERN

The human health contaminant of concern (COC) screening process is described in Section 4.2 of the CRA Methodology and summarized in Appendix A, Volume 2 of the RI/FS Report (Section 2.2).

The human health COC selection process was conducted for surface soil/surface sediment and subsurface soil/subsurface sediment in the UWOEU. Results of the COC selection process are summarized below.

## 2.1 Contaminant of Concern Selection for Surface Soil/Surface Sediment

Detected PCOCs in surface soil/surface sediment samples (Table 1.3) are screened in accordance with the CRA Methodology to identify the COCs.

### 2.1.1 Surface Soil/Surface Sediment Cation/Anion and Essential Nutrient Screen

The major cations and anions that do not have toxicological factors are eliminated from assessments in surface soil/surface sediment in accordance with the CRA Methodology.

The essential nutrient screen for analytes detected in surface soil/surface sediment is presented in Table 2.1. The screen includes PCOCs that are essential for human health and do not have toxicity values. The PRG screen in Section 2.1.2 includes essential nutrients for which toxicity criteria are available. Table 2.1 shows the maximum detected concentrations (MDCs) for essential nutrients, daily intake estimates based on the MDCs, and dietary reference intakes (DRIs). The DRIs are identified in the table as recommended daily allowances (RDAs), recommended daily intakes (RDIs), adequate intakes (AIs), and upper limit daily intakes (ULs). The estimated daily maximum intakes are less than the DRIs. Therefore, these PCOCs were not further evaluated as COCs for surface soil/surface sediment.

### 2.1.2 Surface Soil/Surface Sediment Preliminary Remediation Goals Screen

Table 2.2 compares MDCs and upper confidence limits (UCLs) to the WRW PRGs for each PCOC. If the MDC and the UCL are greater than the PRG, the PCOC is retained for further screening; otherwise, it is not further evaluated. Arsenic, benzo(a)pyrene, dibenz(a,h)anthracene, 2,3,7,8-TCDD (TEQ), cesium-134, cesium-137, radium-228, and uranium-235 in surface soil/surface sediment had MDCs and UCLs that exceeded the PRGs, and were retained as PCOCs.

PRGs were not available for several PCOCs in surface soil/surface sediment. Analytes without PRGs are listed in Table 2.2 and their effect on the conclusions of the risk assessment results is discussed in the uncertainty section (Section 6.0).

### 2.1.3 Surface Soil/Surface Sediment Detection Frequency Screen

Arsenic, benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) were detected in more than 5 percent of surface soil/surface sediment samples and, therefore, were retained for further evaluation in the COC screen (Table 2.2). Dibenz(a,h)anthracene was detected at less than 5 percent (4.8 percent, Table 1.3). Because the MDC for this chemical was less than 30 times the PRG, dibenz(a,h)anthracene was not further evaluated as a COC. A detection frequency screen was not performed for cesium-134, cesium-137, radium-228, and uranium-235 in surface soil/surface sediment because all reported values for radionuclides are considered detects.

### 2.1.4 Surface Soil/Surface Sediment Background Analysis

Results of the background statistical comparison for arsenic, cesium 134, cesium-137, radium-228, and uranium-235 are presented in Table 2.3 and discussed in Attachment 3. Box plots for arsenic, cesium 134, cesium-137, radium-228, and uranium-235 (both UWOEU and background) are provided in Attachment 3. Arsenic is the only PCOC that was statistically greater than background at the 0.1 significance level, and it is evaluated further in the professional judgment section.

Following the CRA Methodology, a statistical comparison to background is not performed for organics; therefore, benzo(a)pyrene and 2,3,7,8 TCDD (TEQ) are carried forward into the professional judgment evaluation.

### 2.1.5 Surface Soil/Surface Sediment Professional Judgment Evaluation

Based on the weight of available evidence evaluated by professional judgment, PCOCs will either be included for further evaluation as COCs or excluded as COCs. The professional judgment evaluation takes into account process knowledge, spatial trends, and pattern recognition. As discussed in Section 1.2 and Attachment 2, the sample results are adequate for use in the professional judgment because they are of sufficient quality for use in the CRA.

As described in Attachment 3, arsenic in surface soil/surface sediment in the UWOEU is not considered a COC because the weight of evidence supports the conclusion that arsenic concentrations in surface soil/surface sediment in the UWOEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. The surface soil/surface sediment UCL is less than three times greater than the PRG (2.41 milligrams per kilogram [mg/kg]) and the risk potential is essentially equivalent to the background risk potential. The concentrations of arsenic in surface soil/surface sediment samples at the UWOEU are similar to the background data set. Therefore, arsenic is not further evaluated quantitatively.

## 2.2 Contaminant of Concern Selection for Subsurface Soil/Subsurface Sediment

Detected PCOCs in subsurface soil/subsurface sediment samples (Table 1.4) are screened in accordance with the CRA Methodology to identify the COCs.

### 2.2.1 Subsurface Soil/Subsurface Sediment Cation/Anion and Essential Nutrient Screen

The major cations and anions that do not have toxicological factors are eliminated from assessments in subsurface soil/subsurface sediment in accordance with the CRA Methodology.

Essential nutrients without toxicity criteria that were detected in subsurface soil/ subsurface sediment in the UWOEU are compared to DRIs in Table 2.4. The estimated daily maximum intakes for these PCOCs, based on the nutrient's MDCs and a subsurface soil ingestion rate of 100 milligrams per day (mg/day), are less than the DRIs. Therefore, these PCOCs were not further evaluated as COCs for subsurface soil/subsurface sediment.

### 2.2.2 Subsurface Soil/Subsurface Sediment Preliminary Remediation Goal Screen

The PRG screen for detected analytes in subsurface soil/subsurface sediment is presented in Table 2.5. Radium-228 was the only PCOC with an MDC and UCL that exceeded the PRG. Therefore, radium-228 was retained as a PCOC.

PRGs were not available for several PCOCs in subsurface soil/subsurface sediment. Analytes without PRGs are listed in Table 2.5 and their effect on the conclusions of the risk assessment results is discussed in the uncertainty section (Section 6.0).

### 2.2.3 Subsurface Soil/Subsurface Sediment Detection Frequency Screen

The detection frequency screen is not performed for radium-228 in subsurface soil/ subsurface sediment because all reported values for radionuclides are considered detects.

### 2.2.4 Subsurface Soil/Subsurface Sediment Background Analysis

Analyses were conducted to assess whether radium-228 concentrations in UWOEU subsurface soil/subsurface sediment are statistically higher than those in background subsurface soil/subsurface sediment at the 0.1 level of significance (1-p less than or equal to 0.1). The subsurface soil/subsurface sediment background data are described in detail in Appendix A, Volume 2 of the RI/FS Report.

The results of the statistical comparisons of the UWOEU data to background data indicate site concentrations for radium-228 are not statistically greater than background at the 0.1 significance level. The results are summarized in Table 2.3 and in Attachment 3. Box plots for radium-228 (both UWOEU and background data) are provided in

Figure A3.3.4 in Attachment 3. Radium-228 in subsurface soil/subsurface sediment is not further evaluated in the professional judgment section.

### 2.2.5 Subsurface Soil/Subsurface Sediment Professional Judgment Evaluation

A professional judgment evaluation for subsurface soil/subsurface sediment at the UWOEU was not performed because no PCOCs were retained after the background analysis.

## 2.3 Contaminant of Concern Selection Summary

A summary of the results of the COC screening process is presented in Table 2.6. Benzo(a)pyrene and 2,3,7,8 TCDD (TEQ) were the only analytes in surface soil/surface sediment selected as COCs in the UWOEU. These COCs are further evaluated quantitatively. No analytes were selected as COCs in subsurface soil/subsurface sediment in the UWOEU.

# 3.0 HUMAN HEALTH EXPOSURE ASSESSMENT

The site conceptual model (SCM), presented in Figure 2.1 of the CRA Methodology and discussed in Appendix A, Volume 2 of the RI/FS Report, provides an overview of potential human exposures at RFETS for reasonably anticipated land use. Two types of receptors, the WRW and WRV, were selected for quantitative evaluation based on the SCM. Exposure point concentrations (EPCs) were calculated for the COCs identified and chemical intakes were estimated using the EPCs for the WRW and WRV receptors.

Tier 1 and Tier 2 EPCs were calculated for the COCs, benzo(a)pyrene, and 2,3,7,8-TCDD (TEQ), in surface soil/surface sediment for the UWOEU. Tier 1 EPCs are based on the UCLs of the arithmetic mean concentration for the EU data set and Tier 2 EPCs are calculated using a spatially weighted averaging approach. For 2,3,7,8 –TCDD (TEQ), Tier 2 calculations could not be calculated because all data were collected within one of the 30-acre grids. The Tier 1 concentrations for 2,3,7,8-TCDD (TEQ) were, therefore, also used for Tier 2 calculations. The methodology for these calculations is provided in Appendix A, Volume 2 of the RI/FS Report. Figure 3.1 shows the 30-acre grid used to calculate the Tier 2 EPCs. Table 3.1 presents the Tier 1 and Tier 2 EPCs for the UWOEU.

Chemical intakes for WRW and WRV exposure pathways were quantified for benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) using the exposure factors listed in Tables 3.2 and 3.3, respectively. Additional information on the estimation of chemical intake is presented in Appendix A, Volume 2 of the RI/FS Report and in the CRA Methodology.

# 4.0 HUMAN HEALTH TOXICITY CRITERIA

Toxicity criteria are used in the risk calculations in Section 5.0. Tables 4.1 and 4.2 present the toxicity criteria (cancer slope factors [CSFs], reference doses [RfDs], and dermal absorption factors) for COCs at the UWOEU. Toxicity criteria are presented for the oral, inhalation, and dermal exposure pathways. Additional information on the human health toxicity assessment is presented in Appendix A, Volume 2 of the RI/FS Report and in the CRA Methodology.

# 5.0 HUMAN HEALTH RISK CHARACTERIZATION

Information from the exposure assessment and the toxicity assessment is integrated in this section to characterize risk to the WRW and WRV receptors. Quantitative risks for cancer and noncancer effects were estimated using the toxicity factors presented in the Toxicity Assessment (Section 4.0) and pathway-specific intakes defined in the exposure assessment (Section 3.0). Details of the risk characterization methods are provided in the CRA Methodology and summarized in Appendix A, Volume 2 of the RI/FS Report.

## 5.1 Wildlife Refuge Worker

This section presents the risk characterization for exposure to COCs at the UWOEU. The WRW receptor was evaluated for exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment. The risk estimates for exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) are summarized in Table 5.1, while Attachment 4 contains the risk calculation tables.

### 5.1.1 Surface Soil/Surface Sediment

The WRW is evaluated for exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment by ingestion, inhalation, and dermal exposure. Radionuclides were not selected as COCs for surface soil/surface sediment. Therefore, radiation cancer risks and doses were not calculated. The estimated excess lifetime cancer risks are calculated and summarized in Tables 5.1 and 5.3 for Tier 1 and Tier 2 EPCs. Noncancer hazards for benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) were not calculated because noncancer toxicity values are not available.

It is important to note that some of the surface soil/surface sediment samples for the UWOEU are located under the Original Landfill cover and, therefore, are not accessible for contact by the WRW. In addition, the 2,3,7,8-TCDD (TEQ) samples are actually located approximately 20 feet bgs. The effect on the HHRA results of using the samples that are located under the Original Landfill cover and below ground surface is evaluated in Section 6.4, Uncertainties Associated with Calculation of Risk.

***Risk Characterization Results Based on Tier 1 EPCs***

The total chemical cancer risk for potential exposure to surface soil/surface sediment by the WRW, based on the Tier 1 EPC, is 8E-06 (Table 5.1). The primary risk driver is benzo(a)pyrene, which comprises 73 percent of the total chemical cancer risk. The risk is predominantly from the ingestion exposure route.

***Risk Characterization Results Based on Tier 2 EPCs***

The total cancer risk for potential exposure to surface soil/surface sediment by the WRW, based on the Tier 2 EPC, is 3E-07 (Table 5.1). The primary risk driver is 2,3,7,8-TCDD (TEQ), which comprises 72 percent of the total chemical cancer risk. The risk is predominantly from the ingestion exposure route.

### 5.1.2 Subsurface Soil/Subsurface Sediment

No COCs were selected in subsurface soil/subsurface sediment. Therefore, it is not necessary to perform a risk characterization for subsurface soil/subsurface sediment in the UWOEU.

### 5.1.3 Wildlife Refuge Worker Total Risk and Hazards

Risk estimates are summed across media to develop an estimate for the total risk to a receptor. This approach is followed only if the COCs in different media exhibit comparable health effects. For the UWOEU, benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) were selected as COCs for surface soil/surface sediment only. Total risk and hazards are summarized in Table 5.3. The surface soil/surface sediment risk estimates for the WRW, based on a Tier 1 EPC, result in an estimated total cancer risk of 8E-06. Because COCs were only calculated for one medium, cumulative risks from exposure to multimedia are not calculated for the UWOEU.

## 5.2 Wildlife Refuge Visitor

This section presents the results of the risk characterization for potential exposure of the WRV receptor to surface soil/surface sediment at the UWOEU. Exposure to subsurface soil/subsurface sediment is not evaluated for WRV.

Risks to the WRV receptor are evaluated for potential exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment by inhalation, ingestion, and dermal exposure. The risk estimates for exposure to this COC are summarized in Table 5.2. Attachment 4 contains the risk calculation tables.

### 5.2.1 Surface Soil/Surface Sediment

The WRV is evaluated for exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment by ingestion, inhalation, and dermal exposure (for organic COCs only). Radionuclides were not selected as COCs for surface soil/surface sediment. Therefore, radiation cancer risks and doses were not calculated. The estimated excess lifetime cancer risks are calculated and summarized in Table 5.2 for Tier 1 and Tier 2 EPCs. Noncancer hazards for benzo(a)pyrene were not calculated because noncancer toxicity values are not available for benzo(a)pyrene.

As noted above for the WRW, some of the surface soil/surface sediment samples for the UWOEU are located under the Original Landfill cover or approximately 20 feet bgs. The effect on the HHRA results of using these samples is evaluated in Section 6.4, Uncertainties Associated with Calculation of Risk.

***Risk Characterization Results Based on Tier 1 EPCs***

The total cancer risk for potential exposure to surface soil/surface sediment by the WRV, based on the Tier 1 EPC, is 9E-06 (Table 5.2). The primary risk driver is benzo(a)pyrene, which comprises 75 percent of the total Tier 1 cancer risk. The ingestion and dermal exposure route are the main contributors to this risk.

***Risk Characterization Results Based on Tier 2 EPCs***

The total chemical cancer risk for potential exposure to surface soil/surface sediment by the WRV, based on the Tier 2 EPC, is 3E-06 (Table 5.2). The primary risk driver is 2,3,7,8-TCDD (TEQ), contributing approximately 69 percent to the risk. The risk is predominantly from the ingestion exposure route.

## 5.3 Summary

Risks to the WRW and WRV were evaluated for potential exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment at the UWOEU. A summary of the cancer risks and noncancer hazards is presented in Table 5.3.

The results of the Tier 1 and Tier 2 risk characterizations indicate that estimated risks for the WRW and WRV are within the target risk range for COCs exhibiting carcinogenic effects (i.e., $1 \times 10^{-6}$ to $1 \times 10^{-4}$) (Table 5.3).

# 6.0 UNCERTAINTIES ASSOCIATED WITH THE HUMAN HEALTH RISK ASSESSMENT

There are various types of uncertainties associated with steps of an HHRA. General uncertainties common to the EUs are discussed in Appendix A, Volume 2 of the RI/FS Report. Uncertainties specific to the EU are described below.

## 6.1 Uncertainties Associated with the Data

Data adequacy for this CRA is evaluated and discussed in Appendix A, Volume 2 of the RI/FS Report. Although there are some uncertainties associated with the sampling and analyses conducted for surface soil/surface sediment and subsurface soil/subsurface sediment at the UWOEU, data are considered adequate for the characterization of risk at the EU. The environmental samples for the UWOEU were collected from 1991 through 2005. The CRA sampling and analysis requirements for the BZ (DOE 2004) specify that the minimum sampling density requirement for surface soil/surface sediment is one five-sample composite for every 30-acre grid cell. This sampling density is exceeded for most of the UWOEU given that there are up to 179 surface soil/surface sediment samples for the entire 524-acre EU. In surface soil/surface sediment, there are up to 217 samples in the UWOEU.

Another source of uncertainty in the data is the relationship of detection limits to the PRGs for analytes eliminated as COCs because they were not detected or had a low detection frequency (i.e., less than 5 percent). The detection limits were appropriate for the analytical methods used, and this is examined in greater detail in Attachment 1.

## 6.2 Uncertainties Associated with Screening Values

The COC screening analyses used RFETS-specific PRGs based on a WRW scenario. The assumptions used in the development of these values were conservative. For example, it is assumed that a future WRW will consume 100 mg of surface soil/surface sediment for 230 days a year for 18.7 years. In addition, a WRW is assumed to be dermally exposed to and inhale surface soil and surface sediment particles in the air. These assumptions are likely to overestimate actual exposures to surface soil for WRWs in the UWOEU because a WRW will not spend 100 percent of his or her time in this area. Exposure to subsurface soil and subsurface sediment is assumed to occur 20 days per year. The WRW PRGs for subsurface soil/subsurface sediment are also expected to conservatively estimate potential exposures because it is unlikely a WRW will excavate extensively in the UWOEU.

### 6.2.1 Uncertainties Associated with Potential Contaminants of Concern without Preliminary Remediation Goals

PCOCs for the UWOEU for which PRGs are not available are listed in Table 6.1.

Uncertainties associated with the lack of PRGs for analytes listed in Table 6.1 are considered small. The listed cations/anions and inorganics are not usually included in HHRAs because they are not expected to result in significant human health impacts. The majority of the listed organics have a low detection frequency and, therefore, are not expected to affect the results of the HHRA. Radionuclide PRGs are available for all detected individual radionuclides. Therefore, the lack of PRGs for gross alpha and gross beta activities is also not expected to affect the results of the HHRA.

## 6.3 Uncertainties Associated with Eliminating Potential Contaminants of Concern Based on Professional Judgment

Arsenic in surface soil/surface sediment was eliminated as a COC based on professional judgment. There is no identified source or pattern of release in the UWOEU and the slightly elevated median values of the UWOEU data for these PCOCs are most likely due to natural variation. The weight of evidence presented in Attachment 3, Section 4.0 supports the conclusion that concentrations of arsenic are naturally occurring and not due to site activities. Uncertainty associated with the elimination of this chemical as a COC is low.

## 6.4 Uncertainties Associated with Calculation of Risk

One of the most important uncertainties in the risk calculations for the UWOEU is associated with the EPCs for benzo(a)pyrene in surface soil/surface sediment. This concentration estimate is biased by two high benzo(a)pyrene hits (one as high as 43,000 µg/kg) from locations underneath the cover of the Original Landfill. Because exposure to soil at these locations is not anticipated, the EPC for benzo(a)pyrene and the associated risks are likely overestimated.

Of the 121 surface soil/surface sediment samples in the UWOEU, 52 samples are located in areas that are now under the Original Landfill cover. As part of the uncertainty analysis, the UCL was calculated for benzo(a)pyrene using only surface soil/surface sediment samples in the UWOEU that are located outside the Original Landfill cover. This UCL (334 µg/kg) is less than the PRG (379 µg/kg); therefore, benzo(a)pyrene would not be identified as a COC for the portion of UWOEU that is outside the Original Landfill cover. Accordingly, risks associated with exposure to benzo(a)pyrene in the UWOEU in areas outside the Original Landfill cover are less than 1E-06.

Exposure to the 2,3,7,8-TCDD (TEQ) in soil is also not anticipated because these samples are located approximately 20 feet bgs. These samples were taken as confirmation samples in an excavation following an accelerated action and, therefore, were classified as surface soil samples. However, the locations are actually approximately 20 feet bgs and not accessible by the WRW or WRV. Therefore, the risks for exposure to 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment are most likely to be overestimated.

## 6.5 Uncertainties Evaluation Summary

Evaluation of the uncertainties associated with the data and the COC screening processes indicates there is reasonable confidence in the conclusions of the UWOEU risk characterization.

# 7.0 IDENTIFICATION OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN

The ECOPC identification process streamlines the ecological risk characterization for each EU by focusing the assessment on ecological contaminants of interest (ECOIs) that are present in the UWOEU. ECOIs are defined as any chemical detected in the UWOEU and are assessed for surface soils and subsurface soils. ECOIs for sediments and surface water are assessed in Appendix A, Volume 15 of the RI/FS Report. The ECOPC process is described in the CRA Methodology and additional details are provided in Appendix A, Volume 2 of the RI/FS Report. A detailed discussion of the SCM, including the receptors of concern, exposure pathways, and endpoints used in the ERA for the UWOEU are also provided in Appendix A, Volume 2 of the RI/FS Report.

The process is based on the SCM presented in the CRA Methodology and described in detail in Appendix A, Volume 2 of the RI/FS Report. The SCM presents the pathways of potential exposure from documented historical source areas (IHSSs and PACs) to the receptors of concern. The most significant exposure pathways for ecological receptors at the UWOEU are the ingestion of plant, invertebrate, or animal tissue that could have accumulated ECOIs from the source areas through direct uptake or dietary routes, as well as the direct ingestion of potentially contaminated media. For terrestrial plants and invertebrates, the most significant exposure pathway is direct contact with potentially contaminated soils.

The receptors of concern that were selected for assessment are listed in Table 7.1, and discussed in detail in Appendix A, Volume 2 of the RI/FS Report, and include representative birds and mammals in addition to the general plant and terrestrial invertebrate communities. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within the UWOEU, their potential to come into contact with ECOIs, and the amount of life history and behavioral information available.

The ECOPC process consists of two separate evaluations, one for the PMJM receptor and one for non-PMJM receptors. The ECOPC identification process for the PMJM is conducted separately from non-PMJM receptors because the PMJM is a federally listed threatened species under the Endangered Species Act (63 FR 26517).

## 7.1 Data Used in the Ecological Risk Assessment

The following UWOEU data are used in the CRA:

- One hundred and seventy-seven surface soil samples were collected and analyzed for inorganics (135 samples), organics (121 samples), and radionuclides (177 samples) (Table 1.2).

- Two hundred and ninety-seven subsurface soil samples were collected and analyzed for inorganics (257 samples), organics (297 samples), and radionuclides (251 samples) (Table 1.2).

A data summary is provided in Table 1.5 for surface soil, Table 1.6 for surface soil in PMJM habitat, and Table 1.7 for subsurface soil.

Sediment and surface water data for the UWOEU also were collected (Section 1.1.4), and these data are evaluated for the ERA in Appendix A, Volume 15 of the RI/FS Report.

The UWOEU has 45 samples occurring in PMJM habitat, which is described in greater detail in Section 1.1.3. Sampling locations and PMJM habitat patches within the UWOEU are shown in Figure 1.5.

## 7.2 Identification of Surface Soil Ecological Contaminants of Potential Concern

ECOPCs for surface soil were identified for non-PMJM and PMJM receptors in accordance with the sequence presented in the CRA Methodology.

### 7.2.1 Comparison with No Observed Adverse Effect Level Ecological Screening Levels

In the first step of the ECOPC identification process, the MDCs of ECOIs in surface soil were compared to receptor-specific no observed adverse effect level (NOAEL) ESLs. NOAEL ESLs for surface soil were developed in the CRA Methodology for three receptor groups: terrestrial vertebrates, terrestrial invertebrates, and terrestrial plants.

*Non-PMJM Receptors*

The NOAEL ESLs for non-PMJM receptors are compared to MDCs in surface soil in Table 7.1. The results of the NOAEL ESL screening analyses for all receptor types are summarized in Table 7.2. Analytes with a "Yes" in any of the "Exceedance" columns in Table 7.2 are further evaluated.

NOAEL ESLs were not available for several ECOI/receptor pairs (Tables 7.1 and 7.2). These ECOI/receptor pairs are discussed as ECOIs with uncertain toxicity (UT) in Section 10.0 along with the potential impacts to the risk assessment.

*PMJM Receptors*

The NOAEL ESLs for PMJM receptors were compared to the MDCs of ECOIs in surface soil collected from PMJM habitat (Table 7.3). The MDCs in surface soil that exceed the NOAEL ESLs are identified in Table 7.3 with a "Yes" in the column heading "MDC>PMJM ESL?"

Analytes for which a PMJM NOAEL ESL is not available are identified with a "N/A" in Table 7.3 under the column heading "PMJM NOAEL ESL." These analytes are discussed in the uncertainty section (Section 10.0) as ECOIs with UT.

### 7.2.2 Surface Soil Frequency of Detection Evaluation

The ECOPC identification process for non-PMJM receptors involves an evaluation of detection frequency for each ECOI retained after the NOAEL screening step. If the detection frequency is less than 5 percent, population-level risks are considered highly unlikely and the ECOI is not further evaluated. 4,4'-DDT, dieldrin, and endrin ketone were each detected once in 89 UWOEU surface soil samples. Detections of 4,4'-DDT, dieldrin, and endrin ketone within UWOEU are presented in Figures 7.1, 7.2, and 7.3, respectively. None of these ECOIs were carried forward in the ECOPC identification process. Population-level risk from one detection within the entire UWOEU is highly unlikely given the biased nature of the sampling within the UWOEU.

### 7.2.3 Surface Soil Background Comparisons

ECOIs retained after the NOAEL ESL screening and the detection frequency evaluation were then compared to site-specific background concentrations where available. The background comparisons are presented in Tables 7.4 and 7.5 and discussed in Attachment 3. The statistical methods used for the background comparison are summarized in the RI/FS Appendix A, Volume 2.

*Non-PMJM Receptors*

The results of the background comparisons for the non-PMJM receptors are presented in Table 7.4. The analytes listed as being retained as ECOIs in Table 7.4 are evaluated further using upper-bound EPCs in the following section.

*PMJM Receptors*

The results of the background comparisons for PMJM receptors are presented in Table 7.5. Attachment 3 presents further discussion of the PMJM background analysis. The analytes listed as "Yes" on Table 7.5 are further evaluated in the following sections.

### 7.2.4 Exposure Point Concentration Comparisons to Threshold ESLs

The ECOIs retained after completion of all previous evaluations for non-PMJM receptors were then compared to threshold ecological screening levels (tESLs) using EPCs specific to small and large home-range receptors. The calculation of EPCs is described in Attachment 3.

Statistical concentrations for each ECOI retained for the tESL screen are presented in Table 7.6. The EPC for small home-range receptors is the 95 percent UCL of the 90th percentile (upper tolerance limit [UTL]), or the MDC in the event that the UTL is greater than the MDC. The EPC for large home-range receptors is the UCL on the mean, or the MDC in the event that the UCL is greater than the MDC.

Small home-range receptors include terrestrial plants, terrestrial invertebrates, mourning dove, American kestrel, deer mouse, and black-tailed prairie dog. These receptors are evaluated by comparing the small home-range EPC (UTL) for each ECOI to the limiting (or lowest) small home-range receptor tESL (if available). In the event that tESLs are not available, the limiting NOAEL ESL is used in accordance with the CRA Methodology.

Large home-range receptors, such as coyote and mule deer, are evaluated by comparing the large home-range EPC (UCL) for each ECOI to the limiting large home-range receptor tESL (if available). In the event that tESLs are not available, the limiting NOAEL ESL is used in accordance with the CRA Methodology.

The EPC comparison to limiting tESLs for small and large home-range receptors is presented in Table 7.7. Analytes that exceed the limiting tESLs are further evaluated by comparing them to the receptor-specific tESLs (if available) to identify receptors of potential concern. Analytes exceeding the limiting tESLs for small home-range receptors are compared to receptor-specific tESLs in Table 7.8, and analytes exceeding limiting tESLs for large home-range receptors are compared to receptor-specific tESLs in Table 7.9

Chemicals that exceed any tESLs (if available) are assessed in the professional judgment evaluation. Any analyte/receptor pairs that are retained through professional judgment are identified as ECOPCs and are carried forward in the risk assessment.

### 7.2.5 Surface Soil Professional Judgment Evaluation

*Non-PMJM Receptors*

Based on the weight-of-evidence, professional judgment described in Attachment 3, boron and molybdenum in surface soil at the UWOEU were not considered ECOPCs for non-PMJM receptors and are not further evaluated quantitatively.

Antimony, copper, nickel, silver, tin, uranium, vanadium, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, 2,3,7,8-TCDD (TEQ) (mammal and bird), and total PCBs were identified as ECOPCs and retained for further evaluation in the risk characterization.

*PMJM Receptors*

Based on the weight-of-evidence, professional judgment described in Attachment 3, all analytes exceeding screening steps for PMJM receptors were identified as ECOPCs and retained for further evaluation in the risk characterization.

Antimony, chromium, copper, manganese, molybdenum, nickel, tin, vanadium, zinc, and total PCBs were identified as ECOPCs and retained for further evaluation in the risk characterization.

### 7.2.6 Summary of Surface Soil Ecological Contaminants of Potential Concern

The ECOPC screening process for surface soil is summarized below for non-PMJM receptors and PMJM receptors.

*Non-PMJM Receptors*

Inorganic, organic, and radionuclide surface soil ECOIs for non-PMJM receptors in the UWOEU were eliminated from further consideration as ECOPCs based on one of the following: 1) the MDC of the ECOI was less than the lowest ESL; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the concentration of the ECOI in UWOEU surface soils was not greater than background surface soils; 4) the upper-bound EPC did not exceed the limiting tESL; or 5) the weight-of-evidence, professional judgment evaluation indicated that the ECOI was not a site-related contaminant of potential concern. Chemicals that were retained are identified as ECOPCs.

A summary of the ECOPC screening process for non-PMJM receptors is presented in Table 7.10. Receptors of potential concern for each ECOPC are also presented. The ECOPC/receptor pairs are evaluated further in Section 8.0 (Ecological Exposure Assessment), Section 9.0 (Ecological Toxicity Assessment), and Section 10.0 (Ecological Risk Characterization).

*PMJM Receptors*

ECOIs in surface soil in PMJM habitat located within the UWOEU were evaluated in the ECOPC identification process. ECOIs were removed from further evaluation in the ECOPC identification process based on one of the following: 1) the MDC of the ECOI was less than the NOAEL ESL for PMJM; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the ECOI concentrations within the PMJM habitat in UWOEU were not statistically greater than those from background surface soils; or 4) the weight-of-evidence, professional judgment evaluation indicated that the ECOI was not a site-related contaminant of potential concern. The results of the ECOPC identification process for the PMJM are summarized in Table 7.11.

## 7.3 Identification of Subsurface Soil Ecological Contaminants of Potential Concern

Subsurface soil sampling locations for soil collected at a starting depth of 0.5 to 8 feet bgs in the UWOEU are identified in Figure 1.7. A data summary for subsurface soil less than 8 feet deep is presented in Table 1.7.

### 7.3.1 Comparison to No Observed Adverse Effect Level Ecological Screening Levels

The CRA Methodology indicates subsurface soil must be evaluated for those ECOIs that have greater concentrations in subsurface soil than in surface soil. In order to conduct the most conservative CRA, subsurface soil is evaluated for all EUs regardless of the presence/absence of a change in concentrations from surface soil and subsurface soil. The MDCs of ECOIs in subsurface soil were compared to NOAEL ESLs for burrowing receptors (Table 7.12). ECOIs with MDCs greater than the NOAEL ESL for the prairie dog are further evaluated in the ECOPC identification process.

NOAEL ESLs are not available for some analytes, and these are identified as "N/A" in Table 7.12. These constituents are considered ECOIs with uncertain toxicity (UT) and are discussed in the uncertainty analysis (Section 10.0).

### 7.3.2 Subsurface Soil Detection Frequency Evaluation

The ECOPC identification process for burrowing receptors involves an evaluation of detection frequency for each ECOI retained after the NOAEL ESL screening step. If the detection frequency is less than 5 percent, population-level risks are considered highly unlikely and the ECOI is not further evaluated. The detection frequencies for chemicals in subsurface soil are presented in Table 1.7. None of the chemicals in subsurface soil at the UWOEU that were retained after the NOAEL ESL screening step had a detection frequency of less than 5 percent. Therefore, no ECOIs were eliminated from further evaluation based on the detection frequency for subsurface soil in the UWOEU.

### 7.3.3 Subsurface Soil Background Comparison

The ECOIs retained after the NOAEL ESL screening and detection frequency evaluation were compared to site-specific background concentrations where available. The background comparisons are presented in Table 7.13 and discussed in Attachment 3. The statistical methods used for the background comparison are summarized in Attachment 3.

The analytes listed as being retained as ECOIs in Table 7.13 are evaluated further using upper-bound EPCs in the following section.

### 7.3.4 Exposure Point Concentration Comparisons to Threshold ESLs

ECOIs retained after all previous evaluations for burrowing receptors are compared to tESLs using EPCs specific to small home-range receptors. The calculation of EPCs is discussed in the CRA Methodology.

Statistical concentrations for each ECOI retained for the tESL screen are presented in Table 7.14. The EPC comparison to tESLs for burrowing receptors is presented in Table 7.15.

### 7.3.5 Subsurface Soil Professional Judgment

ECOIs with subsurface soil concentrations that exceed NOAEL ESLs, which have been detected in more than 5 percent of samples, that are statistically higher at the 0.1 level of significance compared to the background data, and which exceed tESLs are subject to a professional judgment evaluation. However, no ECOIs had subsurface soil concentrations that exceeded tESLs; therefore, no weight-of-evidence, professional judgment evaluation was needed for subsurface soil in the UWOEU.

### 7.3.6 Summary of Subsurface Soil Ecological Contaminants of Potential Concern

All subsurface soil ECOIs for burrowing receptors in the UWOEU were eliminated from further consideration as ECOPCs. These decisions were based on one of the following: 1) the MDC of the ECOI was less than NOAEL ESL for the burrowing receptor; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the concentration of the ECOI in UWOEU subsurface soils was not greater than background subsurface soils; or 4) the upper-bound EPC was less than the tESL. The results of the subsurface soil ECOPC identification process for burrowing receptors are summarized in Table 7.16.

## 7.4 Summary of Ecological Contaminants of Potential Concern

ECOIs in surface and subsurface soil in the UWOEU were evaluated in the ECOPC identification process for non-PMJM receptors, PMJM receptors, and burrowing receptors. Antimony, copper, nickel, silver, tin, uranium, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, 2,3,7,8-TCDD (TEQ) (mammal and bird), and total PCBs were identified as ECOPCs for selected non-PMJM receptors (Table 7.10). Antimony, chromium, copper, manganese, molybdenum, nickel, tin, vanadium, zinc, and total PCBs were identified as ECOPCs for the PMJM (Table 7.11). No chemicals were identified as ECOPCs for burrowing receptors (Table 7.16). No other ECOIs were retained past the professional judgment step of the ECOPC identification process for any other receptor group (non-PMJM receptors, PMJM receptors, or burrowing receptors).

## 8.0 ECOLOGICAL EXPOSURE ASSESSMENT

The ECOPC identification process defined the steps necessary to identify those chemicals that could not reliably be removed from further consideration in the ERA process. The list of ECOPC/receptor pairs of potential concern (Table 8.1) represents those media, chemicals, and receptors in the UWOEU that require further assessment. The characterization of risk defines a range of potential exposures to site receptors from the ECOPCs and a parallel evaluation of the potential toxicity of each of the ECOPCs as well as the uncertainties associated with the risk characterization. This section provides the estimation of potential exposure to surface soil ECOPCs for the receptors identified in Section 7.0 and Table 8.1. Details of the two exposure models, concentration-based exposure and dosage-based exposure, are presented in Appendix A, Volume 2 of the RI/FS Report.

### 8.1 Exposure Point Concentrations

Surface soil EPCs for all non-PMJM receptors were calculated using both Tier 1 and Tier 2 methods as described in the CRA Methodology. The 30-acre grid used for the Tier 2 calculations is shown in Figure 8.1. The Tier 1 and Tier 2 UTLs and UCLs are presented in Table 8.2. The methodology for the calculation of Tier 2 statistics is provided in RI/FS Appendix A, Attachment 2.

Surface soil EPCs for PMJM receptors were calculated for each PMJM habitat patch assuming that all samples were randomly located and weighted equally. The habitat patches showing sample locations exceeding the NOAEL ESL, or three times the NOAEL ESL are shown for ECOPCs in Figure 8.2 (antimony), Figure 8.3 (chromium), Figure 8.4 (copper), Figure 8.5 (manganese), Figure 8.6 (molybdenum), Figure 8.7 (nickel), Figure 8.8 (tin), Figure 8.9 (vanadium), Figure 8.10 (zinc), and Figure 8.11 (total PCBs). The UCL concentrations for each ECOPC were used as EPCs to calculate hazard quotients (HQs). The UCL was not used if there were not sufficient numbers of samples to calculate this value or if it exceeded the MDC. In either case, the MDC was used as a surrogate EPC. The surface soil EPCs for each PMJM patch are presented in Table 8.3. The ECOPCs shown in Table 8.3 represent ECOPCs with patch-specific MDCs greater than their respective ESLs. All ECOPCs that are not detected in a specific patch at concentrations less than their ESLs are excluded from the table.

Surface water EPCs consisted of values that corresponded to the soil EPCs (only for the soil ECOPCs) being used and are used to estimate the total exposure via the surface water ingestion pathway. For example, if the soil EPC statistic was the UCL, then the UCL concentration in surface water (total values only) was calculated as described for soils and selected as the EPC. Surface water EPCs for all ECOPCs are presented in Table 8.4. All surface water data are provided on CD in Attachment 6.

## 8.2 Receptor-Specific Exposure Parameters

Receptor-specific exposure factors are needed to estimate exposure to ECOPCs for each representative species. These include body weight; food, water, and media ingestion rates; and diet composition and respective proportion of each dietary component. Daily rates for intake of forage, prey, water, and incidental ingestion of soils were developed in the CRA Methodology and are presented in Table 8.5 for the receptors of potential concern carried forward in the ERA for the UWOEU.

## 8.3 Bioaccumulation Factors

The measurement or estimation of concentrations of ECOPCs in wildlife food is necessary to evaluate how much of a receptor's exposure is via food versus direct uptake of contaminated media. Conservative BAFs were identified in the CRA Methodology. These BAFs are either simple ratios between chemical concentrations in biota and soil or are based on quantitative relationships such as linear, logarithmic, or exponential equations. The values reported in the CRA Methodology are used as the BAFs for purposes of risk estimation.

## 8.4 Intake and Exposure Estimates

Intake and exposure estimates were completed for each ECOPC/receptor pair identified in Table 8.1. The estimates use the default exposure parameters and BAFs presented in Appendix B of the CRA Methodology and described in the previous subsection. These intake calculations represent conservative estimates of food tissue concentrations calculated from the range of upper-bound EPCs including the Tier 1 and Tier 2 UTLs and UCLs.

***Non-PMJM Receptors***

The intake and exposure estimates for ECOPC/non-PMJM receptor pairs are presented in Attachment 4. A summary of the exposure estimates is presented in Table 8.6.

- Antimony – Exposure estimates for the terrestrial plant, deer mouse (insectivore), and coyote (insectivore);
- Copper – Exposure estimates for the mourning dove (herbivore and insectivore);
- Nickel – Exposure estimates for the mourning dove (insectivore), deer mouse (herbivore and insectivore), and coyote (generalist and insectivore);
- Silver – Exposure estimates for the terrestrial plant;

- Tin – Exposure estimates for the American kestrel, mourning dove (herbivore and insectivore), and deer mouse (insectivore);
- Uranium – Exposure estimates for the terrestrial plant;
- Vanadium – Exposure estimates for the terrestrial plant and deer mouse (insectivore);
- Bis(2-ethylhexyl)phthalate – Exposure estimates for the American kestrel and mourning dove (insectivore);
- Di-n-butylphthalate – Exposure estimates for the American kestrel and mourning dove (insectivore);
- 2,3,7,8-TCDD (TEQ) (mammal and bird) – Exposure estimates for the American kestrel, mourning dove (insectivore), deer mouse (herbivore and insectivore), and coyote (generalist and insectivore); and,
- Total PCBs – Exposure estimates for the American kestrel and mourning dove (herbivore and insectivore).

***PMJM Receptors***

The intake and exposure estimates for ECOPC/PMJM receptor pairs are presented in Attachment 4 and are summarized in Table 8.7 for:

- Antimony
- Chromium
- Copper
- Manganese
- Molybdenum
- Nickel
- Tin
- Vanadium
- Zinc
- Total PCBs

## 9.0 ECOLOGICAL TOXICITY ASSESSMENT

Exposure to wildlife receptors was estimated for representative species of functional groups based on taxonomy and feeding behavior in Section 8.0 in the form of a daily rate of intake for each ECOPC/receptor pair. To estimate risk, soil concentrations (plants and invertebrate exposure) and calculated intakes (birds and mammals) must then be compared to the toxicological properties of each ECOPC. The laboratory-based toxicity benchmarks are termed toxicity reference values (TRVs) and are of several basic types. The NOAEL and no observed effect concentration (NOEC) TRVs are intake rates or soil concentrations below which no ecologically significant effects are expected. The NOAEL and NOEC TRVs were used to calculate the NOAEL ESLs used in screening steps of the ECOPC identification process to eliminate chemicals that have no potential to cause risk to the representative receptors. The lowest observed adverse effects level (LOAEL) TRV is a concentration above which the potential for some ecologically significant adverse effect could be elevated. The threshold TRVs represent the hypothetical dose at which the response in a group of exposed organisms may first begin to be significantly greater than in unexposed receptors and is calculated as the geometric mean of the NOAEL and LOAEL. Threshold TRVs were calculated based on specific data quality rules for use in the ECOPC identification process for a small subset of ECOIs in the CRA Methodology (DOE 2004a).

TRVs for ECOPCs identified for UWOEU were obtained from the CRA Methodology. The pertinent TRVs for the UWOEU are presented for terrestrial plants and invertebrates in Table 9.1 and for birds and mammals in Table 9.2.

## 10.0 ECOLOGICAL RISK CHARACTERIZATION

Risk characterization includes risk estimation and risk description. Details of these components are described in the CRA Methodology and Appendix A, Volume 2 of the RI/FS Report. Predicted risks should be viewed in terms of the potential for the assumptions used in the risk characterization to occur in nature, the uncertainties associated with the assumptions, and in the potential for effects on the population of receptors that could inhabit the UWOEU.

Potential risks to terrestrial plants, invertebrates, birds, and mammals are evaluated using an HQ approach. An HQ is the ratio of the estimated exposure of a receptor to a TRV that is associated with a known level of toxicity, either a no effect level (NOAEL or NOEC) or an effect level (LOAEL or LOEC):

$$HQ = Exposure/TRV$$

As described in Section 8.0, the units used for exposure and TRV depend upon the type of receptor evaluated. For plants and invertebrates, exposures and TRVs are expressed as concentrations (mg/kg soil). For birds and mammals, exposures and TRVs are expressed as ingested doses (milligrams per kilogram receptor body weight per day [mg/kg/BW/day]). In general, if the NOAEL-based HQ is less than 1, then no adverse effects are predicted. If the LOAEL-based HQ is less than 1 but the NOAEL-based HQ is above 1, then some adverse effects are possible, but it is expected that the magnitude and frequency of the effects will usually be low (assuming the magnitude and severity of the response at the LOAEL are not large and the endpoint of the LOAEL accurately reflects the assessment endpoints for that receptor). If the LOAEL-based HQ is greater than or equal to 1, the risk of an adverse effect is of potential concern, with the probability and/or severity of effect tending to increase as the value of the HQ increases.

When interpreting HQ results for non-PMJM ecological receptors, it is important to remember that the assessment endpoint to non-PMJM receptors is based on the sustainability of exposed populations, and risks to some individuals in a population may be acceptable if the population is expected to remain healthy and stable. For threatened and endangered species, such as the PMJM, the interpretation of HQ results is based on potential risks to individuals rather than populations.

HQs were calculated for each ECOPC/receptor pair based on the exposures estimated and TRVs presented in the preceding sections. Risks are discussed and presented to put the assumptions of the risk predictions into a context that can be used to make risk management decisions.

## 10.1 Chemical Risk Characterization

Chemical risk characterization uses quantitative methods to evaluate potential risks to ecological receptors. In this risk assessment, the quantitative method used to characterize chemical risk is the HQ approach. As noted above, HQs are usually interpreted as follows:

| **HQ Values** | | **Interpretation of HQ Results** |
|---|---|---|
| **NOAEL-based** | **LOAEL-based** | |
| ≤ 1 | ≤ 1 | Minimal or no risk |
| > 1 | ≤ 1 | Low level risk[a] |
| > 1 | > 1 | Potentially significant risk |

[a] Assuming magnitude and severity of response at LOAEL are relatively small and based on endpoints appropriate for the assessment endpoint of the receptor considered.

One potential limitation of the HQ approach is that calculated HQ values may sometimes be uncertain due to simplifications and assumptions in the underlying exposure and toxicity data used to derive the HQs. Where possible, this risk assessment provides information on three potential sources of uncertainty, described below.

- **EPCs.** Because surface soil sampling programs in the EU sometimes tended to focus on areas of potential contamination (IHSS/PAC/UBCs), EPCs calculated using the Tier 1 approach (which assumes that all samples are randomly spread across the EU and are weighted equally) may tend to yield an EPC that is biased high. For this reason, a Tier 2 area-weighting approach was used to derive additional EPCs that help compensate for this potential bias. HQs were always calculated based on both Tier 1 and Tier 2 EPCs for non-PMJM receptors. No Tier 2 EPCs were calculated for PMJM receptors due to the limited size of their habitat.

- **Bioaccumulation Factors (BAFs).** For wildlife receptors, concentrations of contaminants in dietary items were estimated from surface soil using uptake equations. When the uptake equation was based on a simple linear model (e.g., $C_{tissue} = BAF * C_{soil}$), the default exposure scenario used a high-end estimate of the BAF (the 90th percentile BAF). However, the use of high-end BAFs may tend to overestimate tissue concentrations in some dietary items. To estimate more typical tissue concentrations, where necessary, an alternative exposure scenario calculated total chemical intake using a 50th percentile (median) BAF and HQs were calculated. The use of the median BAF is consistent with the approach used in the ecological soil screening level (EcoSSL) guidance (EPA 2005).

- **TRVs.** The CRA Methodology used an established hierarchy to identify the most appropriate default TRVs for use in the ECOPC selection. However, in some instances, the default TRV selected may be overly conservative with regard to characterizing population-level risks. The determination of whether the default TRVs are thought to yield overly conservative estimates of risk is addressed in the uncertainty sections below on a chemical-by-chemical basis. When an alternative TRV is identified, the chemical-specific uncertainty sections provide a discussion of why the alternative TRV is thought to be appropriate to provide an alternative estimate of toxicity (e.g., endpoint relevance, species relevance, data quality, chemical form, etc.), and HQs were calculated using both default and alternative TRVs where necessary.

The influences of each of these uncertainties on the calculated HQs were evaluated both alone and in concert in the risk description for each chemical. Uncertainties related to the BAFs, TRVs, and background risk are presented for each chemical in Attachment 5. Where uncertainties were deemed to be high, Attachment 5 provided alternative BAFs and/or TRVs as appropriate based on the results of the uncertainty assessment.

HQs calculated using the default BAFs and HQs with the Tier 1 and Tier 2 EPCs are provided in Tables 10.1 and 10.2 for each ECOPC/receptor pair. Where no LOAEL HQs exceed 1 using the default exposure and toxicity values, no further HQs were calculated regardless of the results of the uncertainty analysis. Because the default HQs are generally the most conservative risk estimations, if low risk is estimated using these values then further reductions of conservatism would only serve to reduce risk estimates further.

Where LOAEL HQs greater than 1 are calculated using default assumptions, and the uncertainty analysis indicated that alternative BAFs and/or TRVs would be beneficial to reduce uncertainty and conservatism, alternative HQs are presented in Table 10.1 as appropriate.

The selection of which EPC (e.g., UTL or UCL) is of primary importance will depend upon the type of receptor and the relative home range size. Only the UTL EPC is provided in Table 10.1 for small home-range receptors, and only the UCL is provided for large home-range receptors. The patch-specific UCL is provided in Table 10.2 for the PMJM receptors.

All calculated exposure estimates and HQ values are also provided in Attachment 4. These include the default and alternative HQs and are calculated using a range of EPCs. The results for each ECOPC are discussed in more detail below.

The risk description incorporates results of the risk estimates along with the uncertainties associated with the risk estimations and other lines of evidence to evaluate potential chemical effects on ecological receptors in the UWOEU following accelerated actions. Information considered in the risk description includes receptor groups potentially affected, type of TRV exceeded (e.g., NOAEL versus LOAEL), relation of EU concentrations to other criteria such as EPA EcoSSLs, and risk above background conditions. In addition, other site-specific and regional factors are considered, such as the use of a given ECOPC within the EU related to historical RFETS activities, comparison of ECOPC concentrations within the UWOEU to the rest of the RFETS site as it relates to background, and/or comparison to regional background concentrations.

### 10.1.1 Antimony

Antimony HQs for terrestrial plants, deer mouse (insectivore), and coyote (insectivore) are presented in Table 10.1. Figure 10.1 shows the spatial distribution of antimony in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Antimony was also identified as an ECOPC for PMJM receptors in Patch #19, #20, and #21.

*HQs Calculated to Characterize Uncertainty*

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions and no alternative HQs were calculated.

For PMJM receptors, the LOAEL HQ in Patch #20 was greater than 1 using the default exposure assumptions. Therefore, an alternative HQ was calculated using an alternative TRV as discussed in Attachment 5. All other LOAEL HQs were less than 1 for the other two patches.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

*Antimony – Risk Description*

Antimony was identified as an ECOPC for terrestrial plants, the deer mouse (insectivore), coyote (insectivore), and PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

*Terrestrial Plants*

For terrestrial plants, HQs were equal to 1 using the Tier 1 and Tier 2 UTL (Table 10.1). However, due to the lack of confidence in the toxicity information on the effects of antimony on plants and HQs equal to 1 using Tier 2 EPCs, it is unlikely that antimony presents a risk to terrestrial plant populations in the UWOEU.

*Non-PMJM Receptors – Small Home-Range*

Potential risks to vertebrate non-PMJM receptors were evaluated, and HQs are presented in Table 10.1. Using the Tier 1 and Tier 2 EPCs, NOAEL HQs greater than 1 were calculated for the deer mouse (insectivore).

All LOAEL HQs were less than 1 for the deer mouse (insectivore). This indicates that risks to populations of insectivorous small mammals are low in the UWOEU.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Antimony samples were available from 26 grid cells (Figure 10.1). NOAEL HQs greater than 1 were calculated in 50 percent of the grid cells and no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (deer mouse [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to antimony.

Overall, risks to small home-range, non-PMJM receptors are likely to be low from exposure to antimony in UWOEU.

*Non-PMJM Receptors – Large Home-Range*

Potential risks to vertebrate large home-range, non-PMJM receptors were evaluated and HQs are presented in Table 10.1. Using the Tier 1 and 2 EPCs, NOAEL HQs greater than 1 (HQs = 2) were calculated for the coyote (insectivore).

No LOAEL HQs greater than 1 were calculated for the coyote (insectivore) under the default exposure scenario.

Based on the results of the HQ calculations and the summary of the uncertainty, risks to the large home-range receptors are likely low due to exposure to antimony in UWOEU surface soils.

*PMJM Receptors*

For the PMJM receptor, NOAEL HQs were greater than 1 in all three patches (Table 10.2). Figure 8.3 presents antimony sampling locations and a comparison to the PMJM ESL.

LOAEL HQs were less than 1 using the default exposure scenario in Patch #19 and #21. However, in Patch #20 the LOAEL HQ was greater than 1 (HQ = 2). As discussed in the uncertainty analysis, the TRVs used to calculate HQs under the default risk scenarios were derived from EPA EcoSSL guidance (EPA 2003) and represent the highest NOAEL that is less than the lowest-bounded LOAEL for either growth, reproduction, or mortality. The default NOAEL and LOAEL TRVs for antimony are based on a decrease in rat progeny weight. The effect of a predicted decrease in birth weight on the PMJM in the UWOEU in relation to the assessment endpoint for the PMJM is unknown.

Given that the geometric mean NOAEL TRV is less than the next lowest, bounded LOAEL TRV, the geometric mean NOAEL provides a useful comparison point versus the default TRV. The geometric mean of the NOAEL TRV using the same endpoints, as presented in EcoSSL guidance, were also used to calculate HQs. Using the geometric mean TRV, no HQs greater than 0.1 were calculated for any EPC including the MDC in any patch.

Because of the elevated HQs calculated using the default TRVs, risks to these PMJM cannot be discounted; however, the lack of calculated HQs exceeding even 0.1 when using the alternative NOAEL TRV, discussed in Attachment 5, indicates that the risk may be somewhat overstated. The uncertainty section discussed the likely overestimation of the predicted invertebrate tissue concentration (30 percent of the PMJM diet), also indicating that the intake calculated and subsequent risk for the PMJM may be overestimated. Given the conservatism of the NOAEL and LOAEL TRVs as well as the potential for overestimation of total intake, risks to PMJM receptors within Patch #20 are considered low to moderate and risks within all other habitat patches at UWOEU are likely low

### 10.1.2 Chromium

The PMJM receptor is the only receptor of concern for chromium. Patch-specific HQs for the PMJM receptor are presented in Table 10.2. Chromium was identified as an ECOPC in Patches #19, #20, and #21.

*HQs Calculated to Characterize Uncertainty*

Uncertainties related to the default HQ calculations provided in Table 10.2 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs and background risks are presented.

For PMJM receptors, NOAEL HQs for all three patches were less than or equal to 1 using both Chromium VI and Chromium III NOAEL TRVs in the HQ calculations. The LOAEL HQs were all less than 1 using the default HQ calculations. Therefore, no alternative HQs were calculated.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

***Chromium – Risk Description***

Chromium was identified as an ECOPC for PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

***PMJM Receptors***

For the PMJM receptor, NOAEL HQs (using both chromium VI and chromium III TRVs) were less than or equal to 1 in all three patches (Table 10.2). Figure 8.3 presents chromium sampling locations and a comparison to the PMJM ESL.

All LOAEL HQs were less than 1 using the default exposure scenario. The results indicate that risks to PMJM from exposure to chromium are likely to be low in all three patches.

### 10.1.3 Copper

Copper HQs for the mourning dove (herbivore and insectivore) are presented in Table 10.1. Figure 10.2 shows the spatial distribution of copper in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Copper was also identified as an ECOPC for PMJM receptors in Patch #20 in the UWOEU.

***HQs Calculated to Characterize Uncertainty***

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions and no alternative HQs were calculated.

For PMJM receptors, the LOAEL and NOAEL HQs were less than 1 in the HQ calculations and no alternative HQs were calculated.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

***Copper Risk Description***

Copper was identified as an ECOPC for the mourning dove (herbivore and insectivore) receptors and PMJM receptors only. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

*Non-PMJM Receptors – Small Home-Range*

NOAEL HQs calculated using Tier 1 EPCs were greater than 1 for the mourning dove (herbivore and insectivore). NOAEL HQs calculated using Tier 2 EPCs were less than or equal to 1 for both receptors.

All LOAEL HQs were less than 1 for both receptors. Risks to populations of receptors from exposure to copper in UWOEU surface soils are, therefore, likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL, threshold, and LOAEL TRVs were used in the HQ calculations. Copper samples were available from 26 grid cells (Figure 10.3). NOAEL HQs greater than 1 were calculated in 96 percent of the grid cells while no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to copper.

*PMJM Receptors*

For the PMJM receptor, the NOAEL HQ was less than 1 in Patch #20 (Table 10.2). Figure 8.4 presents copper sampling locations and a comparison to the PMJM ESL.

All LOAEL HQs were less than 1 using the default exposure scenario. The results indicate that risks to PMJM from exposure to copper are likely to be low in Patch #20.

### 10.1.4 Manganese

The PMJM receptor is the only receptor of concern for manganese. Patch-specific HQs for the PMJM receptor are presented in Table 10.2. Manganese was identified as an ECOPC in Patches #19, #20, and #21.

*HQs Calculated to Characterize Uncertainty*

Uncertainties related to the default HQ calculations provided in Table 10.2 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented..

For PMJM receptors, NOAEL HQs for Patches #19 and #20 were equal to 1 whereas the NOAEL HQ for Patch #21 was greater than 1 (HQ = 2). The LOAEL HQs were all less than 1 using the default HQ calculations. Therefore, no alternative HQs were calculated.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

*Manganese – Risk Description*

Manganese was identified as an ECOPC for PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

*PMJM Receptors*

For the PMJM receptor, NOAEL HQs were equal to 1 in Patches #19 and #20, whereas the NOAEL HQ was greater than 1 (HQ = 2) in Patch #21 (Table 10.2). Figure 8.5 presents manganese sampling locations and a comparison to the PMJM ESL.

All LOAEL HQs were less than 1 using the default exposure scenario. The results indicate that risks to PMJM from exposure to manganese are likely to be low in all three patches.

### 10.1.5 Molybdenum

The PMJM receptor is the only receptor of concern for molybdenum. Patch-specific HQs for the PMJM receptor are presented in Table 10.2. Molybdenum was identified as an ECOPC in Patches #20 and #21.

*HQs Calculated to Characterize Uncertainty*

Uncertainties related to the default HQ calculations provided in Table 10.2 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

For PMJM receptors, NOAEL HQs for Patches #20 and #21 were equal to 1. LOAEL HQs were all less than 1 using the default HQ calculations and no alternative HQs were calculated.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

*Molybdenum – Risk Description*

Molybdenum was identified as an ECOPC for PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

*PMJM Receptors*

For the PMJM receptor, NOAEL HQs were equal to 1 in Patches #20 and #21 (Table 10.2). Figure 8.6 presents molybdenum sampling locations and a comparison to the PMJM ESL.

All LOAEL HQs were less than 1 using the default exposure scenario. The results indicate that risks to PMJM from exposure to molybdenum are likely to be low in both patches.

### 10.1.6 Nickel

Nickel HQs for the mourning dove (insectivore), deer mouse (herbivore and insectivore), and coyote (generalist and insectivore) are presented in Table 10.1. Figure 10.3 shows the spatial distribution of nickel in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Patch-specific HQs for the PMJM receptor (Patches #19, #20, and #21) are presented in Table 10.2.

*HQs Calculated to Characterize Uncertainty*

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

For non-PMJM receptors, only the deer mouse (insectivore) had LOAEL HQs greater than 1, indicating that risks based on the default assumptions could have the potential to be significant. However, the uncertainty analysis presented in Attachment 5 indicated that there were considerable uncertainties and conservatisms in the nickel risk calculations based on both upper-bound BAFs and TRVs. For this reason, alternative HQs were calculated for the deer mouse (insectivore) using both median BAFs and the alternative TRVs presented in the uncertainty analysis. The resulting HQs are presented in Table 10.1

For PMJM receptors, NOAEL HQs greater than 3 and LOAEL HQs greater than 1 were calculated using the UCL EPC in all three patches (#19, #20, and #21) indicating that risks based on the default assumptions have the potential to be significant. However, as discussed above, the uncertainty analysis presented in Attachment 5 indicated that there were considerable uncertainties and conservatisms in the nickel risk calculations based on both upper-bound BAFs and TRVs. For this reason, alternative HQs were calculated for the PMJM using both median BAFs and the alternative TRVs presented in the uncertainty analysis. The resulting HQs are presented in Table 10.2

Although risks to all receptors except the deer mouse (insectivore) and PMJM receptors were determined to be low using the more conservative default HQs, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

*Nickel – Risk Description*

Nickel was identified as an ECOPC for the mourning dove (insectivore), deer mouse (herbivore and insectivore), PMJM, and coyote (generalist and insectivore). Information on the historical use and a summary of site data and background data are provided in Attachment 3.

*Non-PMJM Receptors – Small Home-Range*

For the non-PMJM receptors, NOAEL HQs were greater than 1 for the mourning dove (insectivore), deer mouse (insectivore), and coyote (generalist and insectivore) under the default exposure/TRV scenarios (Table 10.1). Threshold HQs were also greater than 1 for the mourning dove under default exposure/TRV scenarios. LOAEL HQs for all non-

PMJM receptors (except deer mouse [insectivore]) were, however, less than or equal to 1 for all exposure scenarios. The deer mouse (insectivore) had LOAEL HQs greater than 1 under the default exposure scenarios indicating the potential for significant risk. Risks to the mourning dove (insectivore) and deer mouse (herbivore) are likely to be low because no LOAEL HQs greater than 1 were calculated using the default BAFs and TRVs prescribed by the CRA Methodology. Risks to the deer mouse (insectivore) require more evaluation.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Nickel samples were available from 26 grid cells (Figure 10.6). NOAEL HQs greater than 10 were calculated in 100 percent of the grid cells. LOAEL HQs greater than 1 but less than 5 were calculated in 96 percent of the grid cells for the most sensitive receptor (deer mouse [insectivore]). The results of the grid-cell analysis indicate that potentially significant risks from average exposure to sub-populations of insectivorous small mammals cannot be dismissed and requires further evaluation.

The uncertainty analysis discussed the potential for risks to be overestimated using the default exposure models and TRVs due to LOAEL HQs greater than 1 calculated at UCL and UTL background soil concentrations. Because risks are not generally expected at normal background concentrations, particularly at the low end of normal background concentrations, the uncertainty analysis recommended several steps to provide a less uncertain assessment of risks. Background concentrations of nickel (MDC = 14.0 mg/kg) do not appear to be elevated over what would be expected in the vicinity of the site. Attachment 3 presents background concentrations for Colorado and bordering states where nickel concentrations range from 5 to 700 mg/kg, with an average concentration of 18.8 mg/kg.

For the deer mouse (insectivore), LOAEL HQs in background (UTL and UCL HQs = 3) are similar as those calculated for UWOEU surface soils with the exception of the Tier 1 UTL (HQ = 5). These results indicate that risks to insectivorous deer mouse populations within UWOEU are similar to those offsite. This also indicates that HQ calculations for the deer mouse (insectivore) receptor using the default HQ calculation may over-predict risk and are not different from those predicted at background concentrations.

The uncertainty analysis discussed these uncertainties and conservatisms related to both upper-bound BAFs used in the intake estimates and in the TRVs used to calculate HQs. Alternative intake rates were calculated for those receptors ingesting invertebrates in their diet. In addition, HQs were also calculated using alternative TRVs from Sample et al. (1996).

No LOAEL HQs greater than 1 were calculated using the default TRVs under the alternative (median) BAF exposure scenario. In addition, no HQs greater than 1 were calculated for any receptor using either the alternative NOAEL or LOAEL TRV under the default BAF scenario or the alternative BAF scenario.

Risks to the deer mouse (insectivore) may be slightly higher than those predicted for the other receptors. While the TRVs used for the NOAEL and LOAEL appear to be sound TRVs based on appropriate endpoints, the exposure models used in the assessment result in elevated risks as minimum background concentrations using those TRVs. When the upper-bound BAF for estimation of invertebrate tissue concentrations was replaced with the median value, no LOAEL HQs greater than 1 for the deer mouse (insectivore) were calculated. Similarly, when the TRVs from Sample et al. (1996) were used instead of the PRC TRVs, no HQs greater than 1 were calculated using either the NOAEL or the LOAEL TRV. The HQs were less than 1 whether the upper-bound or median BAF were used. These calculations indicate that while risks to the deer mouse (insectivore) may be greater than those predicted to the other receptors, they may be over-predicted using the default input parameters provided in the CRA Methodology. The lack of elevated HQs when less conservative, yet still reasonable alternative values were used lends support to this conclusion. Therefore, risks to the deer mouse (insectivore) are likely to be low.

*Non-PMJM Receptors – Large Home-Range*

NOAEL HQs were greater than 1 for the coyote (generalist and insectivore) under the default exposure/TRV scenarios (Table 10.1). LOAEL HQs for both receptors were less than or equal to 1 for all exposure scenarios. Because no LOAEL HQs greater than 1 were calculated for either receptor using the default exposure and toxicity assumptions, risks to large home-range receptors from exposure to nickel in UWOEU are likely to be low.

*PMJM Receptor*

For the PMJM receptor, NOAEL HQs equal to 30, 31, and 31 were calculated for Patches #19, #20, and #21, respectively. LOAEL HQs were equal to 3 for all three patches indicating a potential for significant risk to the PMJM.

As discussed in the uncertainty analysis, the default exposure model and TRV resulted in an ESL less than the minimum detected background surface soil concentration. The default LOAEL for nickel was selected from the same study and predicts an increase in pup mortality, but only at intake rates that would result in a back-calculated soil concentration (4.8 mg/kg) that is equal to the minimum detection in background surface soils. However, the HQ results indicate that more evaluation is necessary to estimate potential risk to the PMJM receptor.

Risks calculated using the background UTL/UCL as EPCs indicate potentially significant levels of risk, with the NOAEL HQ equal to 27 and 20 for the UTL and UCL, respectively. LOAEL HQs equaled 3 and 2, respectively, for the same EPCs. As discussed for the deer mouse (insectivore), this indicates that the risks calculated using the default exposure models and/or TRVs from the CRA Methodology may be over-predicted when because effects are generally not expected in the range of natural background concentrations and are highly unlikely at the lowest end of that range. Risks to the PMJM receptor calculated using the default exposure model and TRVs within the UWOEU are similar to those calculated in background areas. These results indicate that actual risks may be overstated and further evaluation of risks to PMJM is necessary.

The alternative NOAEL TRV, discussed in the uncertainty analysis (Sample et al. 1996), is protective of body weight in neonate rats and provides a reasonable alternative no-effect level for PMJM. The LOAEL was derived from the same study and is predictive of a significant reduction in neonate rat body weights.

The LOAEL HQs were less than or equal to 1 for the PMJM using the median soil-to-invertebrate BAF and the PRC (1994) LOAEL TRV. Similarly, no HQs (NOAEL or LOAEL) were greater than 1 using the upper-bound soil-to-invertebrate BAF and the alternative TRVs.

Overall, risks to PMJM receptors in UWOEU do not appear to be elevated above background concentrations. The combined lines of evidence indicate that risks to the PMJM receptor are low in all three patches. HQs calculated in these patches are similar to those calculated using background data, and alternative HQ calculations indicate that risks may be much lower than predicted using the default HQ calculations in the three patches.

### 10.1.7 Silver

Silver HQs for terrestrial plants are presented in Table 10.1. Figure 10.4 shows the spatial distribution of silver in relation to the plant ESL.

#### *HQs Calculated to Characterize Uncertainty*

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are also presented.

The terrestrial plant receptors had a NOEC HQ greater than 1 (HQ = 2). No LOEC TRV was available, therefore, it is unclear whether risks are low or potentially significant using only the default ESL. The uncertainty analysis did not identify any alternative toxicity information. Therefore, no alternative HQs were calculated.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

#### *Silver – Risk Description*

Silver was identified as an ECOPC for terrestrial plants only.

Information on the historical use and a summary of site data and background data are provided in Attachment 3.

#### *Terrestrial Plants*

For terrestrial plants, the Tier 1 HQ was greater than 1 (HQ = 2), whereas the Tier 2 HQ was less than 1 (Table 10.1). All HQs were less than 1 when the alternative screening value (discussed in the uncertainty analysis in Attachment 5) was used.

The low HQs combined with the uncertain nature of both ESLs and the lack of known releases indicate that risks to populations of terrestrial plants from silver in surface soils is low.

### 10.1.8 Tin

Tin HQs for the mourning dove (herbivore and insectivore), American kestrel, and deer mouse (insectivore) are presented in Table 10.1. Figure 10.5 shows the spatial distribution of tin in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Tin was also identified as an ECOPC for PMJM receptors in Patches #19 and #21.

*HQs Calculated to Characterize Uncertainty*

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions, and no alternative HQs were calculated.

For PMJM receptors, the LOAEL HQs were less than 1 in the HQ calculations, and no alternative HQs were calculated.

However, care should be taken to review the chemical specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

*Tin – Risk Description*

Tin was identified as an ECOPC for the mourning dove (herbivore and insectivore), American kestrel, the deer mouse (insectivore), and the PMJM receptor.

Information on the historical use and a summary of site data and background data are provided in Attachment 3.

*Non-PMJM Receptors – Small Home-Range*

For the non-PMJM receptors, potential risks from exposure to tin were evaluated using a range of EPCs, default exposure scenarios, and default TRVs. NOAEL HQs were greater than 1 for the mourning dove (insectivore) and deer mouse (insectivore). LOAEL HQs for all four receptors were less than 1. The lack of HQs calculated when using effects-based TRVs indicates that risk to non-PMJM small home-range receptors is likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Tin samples were available from 26 grid cells (Figure 10.5). NOAEL HQs greater than 1 were calculated in 43 percent of the grid cells while no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors result in low risk from exposure to tin.

The uncertainty section discussed the uncertainties and likely conservatisms in the BAFs used to estimate tissue concentrations. Because no HQs greater than 1 were calculated using the LOAEL TRV, risks to non-PMJM receptor populations in the UWOEU are likely to be low.

***PMJM Receptors***

For the PMJM receptor, NOAEL HQs were greater than 1 in Patches #19 and #21 (Table 10.2). Figure 8.8 presents tin sampling locations and a comparison to the PMJM ESL.

All LOAEL HQs were less than 1 using the default exposure scenario. The results indicate that risks to PMJM from exposure to tin are likely to be low in both patches.

### 10.1.9 Uranium

Uranium HQs for terrestrial plants are presented in Table 10.1. Figure 10.6 shows the spatial distribution of uranium in relation to the plant ESL.

***HQs Calculated to Characterize Uncertainty***

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

The terrestrial plant receptors had a NOEC HQ greater than 1. An alternative LOEC TRV was available, therefore, this alternative HQ was also considered in the analysis.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

***Uranium – Risk Description***

Uranium was identified as an ECOPC for terrestrial plants only.

Information on the historical use and a summary of site data and background data are provided in Attachment 3.

***Terrestrial Plants***

For terrestrial plants, the Tier 1 HQ was greater than 1 whereas the Tier 2 HQ was equal to 1 (Table 10.1). The summary of uranium toxicity in Efroymson et al. (1997a) places low confidence in the NOAEL ESL value because it is based only on one study. The only alternative TRV that could be located was an alternative LOEC (Efroymson et al. 1997a). NOAEL HQs using both the screening ESL and the alternative LOEC were greater than 1 using Tier 1 EPCs but were less than or equal to 1 using Tier 2 EPCs. Although toxicity information is limited and there is low confidence in the ESL values, it is unlikely that uranium presents a risk to terrestrial plant populations in the UWOEU.

### 10.1.10 Vanadium

Vanadium HQs for terrestrial plants and the deer mouse (insectivore) are presented in Table 10.1. Figure 10.7 shows the spatial distribution of vanadium in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Vanadium was also identified as an ECOPC for PMJM receptors in Patches #19, #20, and #21. Patch-specific HQs for the PMJM receptor are presented in Table 10.2.

*HQs Calculated to Characterize Uncertainty*

Uncertainties related to the default HQ calculations provided in Tables 10.1 and 10.2 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions, and no alternative HQs were calculated.

For PMJM receptors, NOAEL HQs for all three patches were greater than 1 (HQs = 2). LOAEL HQs were all less than 1 using the default HQ calculations, and no alternative HQs were calculated.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

*Vanadium – Risk Description*

Vanadium was identified as an ECOPC for terrestrial plants, deer mouse (insectivore), and PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

*Terrestrial Plants*

For terrestrial plants, the Tier 1 and Tier 2 HQs were greater than 1 (Table 10.1). The summary of vanadium toxicity in Efroymson et al. (1997a) places low confidence in the NOAEL ESL value because the value was not based on any specific study. The only alternative TRV that could be located was an alternative LOEC (Efroymson et al. 1997a). Using the alternative LOEC, the Tier 1 HQ was equal to 1, and the Tier 2 HQ was less than 1. Although toxicity information is limited and there is low confidence in the ESL values, it is unlikely that vanadium presents a risk to terrestrial plant populations in the UWOEU.

*Non-PMJM Receptors – Small Home-Range*

Potential risks to vertebrate non-PMJM receptors were evaluated and HQs are presented in Table 10.1. Using the Tier 1 EPC, a NOAEL HQ greater than 1 (HQ = 2) was calculated for the deer mouse (insectivore). The Tier 2 NOAEL HQ was equal to 1.

All LOAEL HQs were less than 1 for the deer mouse (insectivore). This indicates that risks to populations of insectivorous small mammals are low in the UWOEU.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Vanadium samples were available from 26 grid cells (Figure 10.1). NOAEL HQs greater than 1 were calculated in 73 percent of the grid cells, and no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (deer mouse [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to vanadium.

Overall, risks to small home range, non-PMJM receptors are likely to be low from exposure to vanadium in UWOEU.

*PMJM Receptors*

For the PMJM receptor, NOAEL HQs were greater than 1 (HQs = 2) (Table 10.2). Figure 8.9 presents vanadium sampling locations and a comparison to the PMJM ESL.

All LOAEL HQs were less than 1 using the default exposure scenario. The results indicate that risks to PMJM from exposure to vanadium are likely to be low in all three patches.

### 10.1.11 Zinc

The PMJM receptor is the only receptor of concern for zinc. Patch-specific HQs for the PMJM receptor are presented in Table 10.2. Zinc was identified as an ECOPC in Patches #19, #20, and #21.

*HQs Calculated to Characterize Uncertainty*

Uncertainties related to the default HQ calculations provided in Table 10.2 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

For PMJM receptors, NOAEL HQs for all three patches were greater than 1 (HQs = 2 or 3). LOAEL HQs were all less than 1 using the default HQ calculations, and no alternative HQs were calculated.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

*Zinc – Risk Description*

Zinc was identified as an ECOPC for PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

*PMJM Receptors*

For the PMJM receptor, NOAEL HQs were greater than 1 in all three patches (Table 10.2). Figure 8.10 presents zinc sampling locations and a comparison to the PMJM ESL.

All LOAEL HQs were less than 1 using the default exposure scenario. The results indicate that risks to PMJM from exposure to zinc are likely to be low in all three patches.

### 10.1.12 Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexylphthalate) HQs for the American kestrel and mourning dove (insectivore) are presented in Table 10.1. Figure 10.8 shows the spatial distribution of bis(2-ethylhexyl)phthalate in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

*HQs Calculated to Characterize Uncertainty*

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

No LOAEL HQs greater than 1 were calculated for any non-PMJM receptor. Therefore, no alternative HQ calculations are provided.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

*Bis(2-ethylhexyl)phthalate – Risk Description*

There is no identified source in the UWOEU for bis(2-ethylhexyl)phthalate, which was identified as an ECOPC for the American kestrel and mourning dove (insectivore) receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

*Non-PMJM Receptors – Small Home-Range*

Potential risks to receptors of concern were estimated using a range of EPCs. NOAEL HQs were greater than 1 for the mourning dove (insectivore) (Table 10.1). NOAEL HQs were less than or equal to 1 for the American kestrel. All LOAEL HQs were less than 1 for both receptors. Because no effects-based TRVs resulted in HQs greater than 1, risks to non-PMJM receptors are likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Bis(2-ethylhexyl)phthalate samples were available from 12 grid cells (Figure 10.8). NOAEL HQs greater than 1 were calculated in 100 percent of the grid cells, while no grids had LOAEL HQs greater than 1 for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to bis(2-ethylhexyl)phthalate.

These lines of evidence along with the uncertainty analysis indicated that risks to non-PMJM receptors are likely low.

### 10.1.13 Di-n-butylphthalate

Di-n-butylphthalate HQs for American kestrel and mourning dove (insectivore) are presented in Table 10.1. Figure 10.9 shows the spatial distribution of di-n-butylphthalate in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

*HQs Calculated to Characterize Uncertainty*

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

LOAEL HQs greater than 1 were calculated for the mourning dove (insectivore) receptor. However, as discussed in the uncertainty analysis, no alternative calculations are available for di-n-butylphthalate.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

***Di-n-butylphthalate – Risk Description***

There is no identified source in the UWOEU for di-n-butylphthalate, which was identified as an ECOPC for the American kestrel and mourning dove (insectivore) receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

***Non-PMJM Receptors – Small Home-Range***

Potential risks to receptors of concern were estimated using a range of EPC TRVs. NOAEL HQs were greater than 1 for the mourning dove (insectivore) and American kestrel (Table 10.1). LOAEL HQs were also greater than 1 for the mourning dove (insectivore) but were less than 1 for the American kestrel. Risks to the American kestrel are, therefore, likely to be low from exposure to di-n-butylphthalate. Risks to the mourning dove (insectivore) have the potential to be significant and further evaluation is required.

As discussed in the uncertainty analysis, the NOAEL TRV was estimated from the LOAEL TRV, which is based on the prediction of eggshell-thinning effects in birds. It is unclear where the threshold for effects lies between the NOAEL and the LOAEL TRV.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Di-n-butylphthalate samples were available from 12 grid cells (Figure 10.9). NOAEL HQs greater than 1 were calculated in 100 percent of the grid cells. One hundred percent of the LOAEL HQs were between 1 and 5 for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors requires further evaluation.

The uncertainty analysis discussed the uncertainty in the BAFs used in the exposure models and the potential for overestimation of invertebrate and small mammal tissue concentrations. It is, therefore, likely that risks are somewhat overestimated. Given that the highest LOAEL HQ calculated equaled 3, other lines of evidence indicate a possibility for overestimation of risk, and there is no known source, risks to the mourning dove (insectivore) receptor are likely low.

### 10.1.14 Total Dioxin (2,3,7,8 TCDD TEQ for mammals and birds)

HQs for 2,3,7,8-TCDD (TEQ) for mammals and birds for the mourning dove (insectivore), American kestrel, deer mouse (herbivore and insectivore), and coyote (generalist and insectivore) are presented in Table 10.1. Figure 10.10 shows the spatial distribution of 2,3,7,8-TCDD (TEQ) for mammals and birds in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

***HQs Calculated to Characterize Uncertainty***

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

For non-PMJM receptors, only the deer mouse (insectivore) had a Tier 1 LOAEL HQ greater than 1 (HQ = 2) using the default exposure assumptions. No Tier 2 NOAEL or LOAEL HQs were calculated because of the small dataset on a grid basis. No alternative HQs were calculated because of the lack of viable alternative BAFs or TRVs and because of the assumption that a Tier 2 LOAEL HQ would have been less than 1 for the deer mouse (insectivore).

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

***Dioxin (Total) – Risk Description***

2,3,7,8-TCDD (TEQ) were identified as an ECOPC for the mourning dove (insectivore), American kestrel, deer mouse (herbivore and insectivore), and coyote (generalist and insectivore).

***Non-PMJM Receptors – Small home-range***

Potential risks from exposure to total dioxin were evaluated using a range of EPCs. All Tier 1 NOAEL HQs were greater than 1 for the mourning dove (insectivore), American kestrel, and deer mouse (herbivore and insectivore)(Table 10.1). All Tier 1 LOAEL HQs were less than or equal to 1 for the mourning dove (insectivore), American kestrel, and deer mouse (herbivore). The Tier 1 LOAEL for the deer mouse (insectivore) was greater than 1 (HQ = 2). No Tier 2 NOAEL or LOAEL HQs were calculated because of the small data set on a grid basis. Given the overall lack of Tier 1 LOAEL HQs greater than 1, risks to non-PMJM receptors from dioxin in surface soils in the UWOEU are likely low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Total PCB samples were available from 1 grid cell (Figure 10.9). A LOAEL and NOAEL HQ greater than 1 but less than 5 was calculated in the one grid cell with dioxin for the most sensitive receptor (mourning dove [insectivore]). Although the analysis is limited because of the small sample size, the results of the grid-cell analysis generally indicates that the average exposure to sub-populations of small home-range receptors indicate low risk from exposure to total dioxin.

***Non-PMJM Receptors – Large Home-Range***

NOAEL HQs were greater than 1 for the coyote (generalist and insectivore) under the default exposure/TRV scenarios (Table 10.1). LOAEL HQs for both receptors were less than 1 for all exposure scenarios. Since no LOAEL HQs greater than 1 were calculated for either receptor using the default exposure and toxicity assumptions, risks to large home range receptors from exposure to total dioxin in UWOEU are likely to be low.

### 10.1.15 Total PCBs

HQs for total PCBs for the mourning dove (herbivore and insectivore) and American kestrel are presented in Table 10.1. Figure 10.11 shows the spatial distribution of total PCBs in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Total PCBs were also identified as an ECOPC for PMJM receptors in Patch #20.

***HQs Calculated to Characterize Uncertainty***

Uncertainties related to the default HQ calculations provided in Table 10.1 are discussed in detail in Attachment 5. Uncertainties related to BAFs, TRVs, and background risks are presented.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions, and no alternative HQs were calculated.

For PMJM receptors, the LOAEL HQs were less than 1 in the HQ calculations, and no alternative HQs were calculated.

However, care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors regardless of whether alternative HQs are provided.

***Total PCBs – Risk Description***

Total PCBs were identified as an ECOPC for the mourning dove (herbivore and insectivore), American kestrel, and PMJM receptors.

*Non-PMJM Receptors – Small home-range*

Potential risks from exposure to total PCBs were evaluated using a range of EPCs. Tier 1 NOAEL HQs were greater than 1 for the mourning dove (insectivore) and the American kestrel whereas Tier 2 HQs were equal to 1 (Table 10.1). NOAEL HQs were less than 1 for the mourning dove (herbivore). LOAEL HQs were less than or equal to 1 for the mourning dove (herbivore and insectivore) and American kestrel. Given the lack of LOAEL HQs greater than 1, risks to non-PMJM receptors from total PCBs in surface soils in the UWOEU are likely low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Total PCB samples were available from 11 grid cells (Figure 10.11). NOAEL HQs greater than 1 were calculated in 27 percent of the grid cells, while no grids had LOAEL HQs greater than 1 for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors indicate low risk from exposure to total PCBs.

*PMJM Receptors*

For the PMJM receptor, the NOAEL HQ was equal to 1 in Patch #20 (Table 10.2). Figure 8.11 presents total PCBs sampling locations and a comparison to the PMJM ESL.

The LOAEL HQ was less than 1 using the default exposure scenario. The results indicate that risks to PMJM from exposure to total PCBs are likely to be low in Patch #20.

## 10.2 Ecosystem Characterization

An ecological monitoring program has been underway since 1991 when baseline data on wildlife species were gathered (Ebasco 1992). The purpose of this long-term program was to monitor specific habitats to provide a sitewide database from which to monitor trends in the wildlife populations at RFETS. This type of monitoring program provides localized information that can also be used for analysis at a landscape level to monitor the population trends and general health of the Rocky Flats ecosystem. Permanent transects through three basic habitats were run monthly for more than a decade (K-H 2002). Observations were recorded concerning the abundance, distribution, and diversity of wide-ranging wildlife species, including observations of migratory birds, raptors, coyotes, and deer. Data on small mammal populations is limited. Small mammal monitoring occurred through several tasks in the monitoring program. The Ecological Monitoring Program (DOE 1995) established permanent transects for small mammal monitoring in three habitat types; xeric grasslands, mesic grasslands, and riparian habitats. Preble's mouse studies established small mammal trapping in nearly all riparian habitats across the site (K-H 1998, 1999, 2000, 2001, 2002).

Migratory birds were tracked during all seasons, but most notably during the breeding season. Over 8 years of bird survey data were collected on 18 permanent transects. Field observations were summarized into species richness and densities by habitat type. Habitats comprised the general categories of grasslands, woodlands, and wetlands. However, summaries in annual reports are grouped by habitat types across RFETS and not within EUs because EU boundaries were determined well after the monitoring program had begun. Additionally, wide-ranging animals may use habitat in several EUs and do not recognize EU boundaries.

Summarizing songbird surveys over the breeding season, diversity indices for RFETS for all habitats combined over 8 years of observations (1991, and 1993 to 1999) show a steady state in diversity of bird communities (K-H 2000). Among habitats, results were similar with the exception of an increasing trend in species richness and a decreasing trend in bird densities in woodland habitats. Woodland bird communities consistently show the highest diversity when compared with bird communities in wetlands and grasslands. The decreasing trend can be mostly attributed to transient species (i.e., those species not usually associated with woody cover) except for red-tailed hawk (*Buteo jamaicensis*) and American goldfinch (*Carduelis tristis*). The red-tailed hawk change in density can be attributed to a loss of nesting sites in Upper Woman Creek during the survey period. Goldfinch abundance can be heavily influenced by the availability of food sources.

A subgroup of migratory birds is neotropical migrants, which show declining populations in North America (Audubon 2005, Nature Conservancy 2005). Most of this decline is thought to be due to conversion of forest land to agriculture in the tropics, and conversion to real estate development in North America. Grassland birds that are neotropical migrants are also in decline. However, over the last 5 years on RFETS, the declining trends have not been observed, and densities for this group show an increase.

Raptors, big game species, and carnivores were observed through relative abundance surveys and multi-species surveys (16 permanent transects) that provide species-specific sitewide counts. Raptors were noted on relative abundance surveys and nest sites were visited repeatedly during the nesting season to confirm nesting success. The three most common raptors at RFETS are red-tailed hawk, great horned owl (*Bubo virginianus*), and American kestrel (*Falco sparverius*) (K-H 2002). One Swainson's hawk nest in North Walnut Creek near the A-1 Pond, and one great horned owl nest was noted within South Walnut Creek (Ryon 2005). All nests typically fledged two young of each species, except kestrels, which usually fledged two to three young. Each species had a successful nesting season each year during the monitoring period from 1991 to 1999 with one exception. This exception was the loss of the red-tailed hawk nest in Upper Woman Creek (K-H 1997, 1998) due to weather. The continued presence of nesting raptors at RFETS (K-H

2002) indicates that habitat quality and protection from human disturbance have contributed to making RFETS a desirable location for raptors to reproduce. Adequate habitat provides essential seasonal requirements. RFETS is estimated to be at optimum population density for raptors given available habitat and territorial nature of these species (K-H 2000).

Two deer species inhabit RFETS: mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*). No white-tailed deer were present at RFETS in 1991 when monitoring began (K-H 2002). In 2000 (K-H 2001) the population of white-tailed deer was estimated to be between 10 and 15 individuals. White-tailed deer frequent No Name Gulch Drainage Exposure Unit (NNEU), but spend the majority of their time in LWOEU. Mule deer frequent all parts of RFETS (14 $mi^2$) year-round. The RFETS population from winter counts is estimated at a mean 125 individuals (n = 7), with a density of 14 deer per square mile (K-H 2000, 2002). Winter mule deer counts have varied from 100 to 160 individuals over the monitoring period (1994 to 2000) with expected age/sex class distributions (K-H 2001). The mule deer populations from RFETS have been increasing at a steady state with good age/sex distributions (K-H 2001) over time and similar densities when compared to other "open" populations that are not hunted. This provides a good indicator that habitat quality is high and that site activities have not affected deer populations. It is unlikely that deer populations are depressed or reproduction is affected by contaminants. A recent study on actinides in deer tissue found that plutonium levels were near or below detection limits (Todd and Sattelberg 2004). This provides further support that the deer population is healthy.

Coyotes (Canis latrans) are the top mammalian predator at RFETS. They prey upon mule deer fawns and other smaller prey species. The number of coyotes using the site has been estimated at 14 to 16 individuals (K-H 2002). Through surveys across the site, coyotes have been noted having reproduction success with as many as six dens active in 1 year (Nelson 2003). Typically at RFETS, three to six coyote dens support an estimated 14 to 16 individuals at any given time (K-H 2001). Coyotes have exhibited a steady population over time, thus, indicating their prey species continue to be abundant and healthy.

Small mammals have been trapped in the UWOEU over the last decade (Ebasco 1992, DOE 1995, K-Hill 1999, K-Hill 2002) under the Ecological Monitoring Program. No long-term monitoring sites were established in Woman Creek under the Ecological Monitoring Program outside of Preble's mouse studies. Small mammal trapping was conducted initially during a NEPA baseline survey in 19991 and continued in the course of monitoring Preble's mice. Results from the baseline study (Ebasco 1992) revealed typical small mammal communities with normal densities of each species in grassland, wetland, and riparian habitats (Fitzgerald et. al. 1994). Preble's mice (*Zapus hudsonius preblei*) have been captured in UWOEU over the last decade and were discovered during the baseline survey (Ebasco 1992). Preble's mice have persisted over time but apparently experienced a decrease in population density in the mid-1990's (DOE 1995, K-H 1998). Current populations appear to have recovered from the decline in recent years (K-H 2001, 2002). Common species found in riparian areas have also been captured with Preble's mice indicating a typical community of small mammals in the UWOEU. Results of small mammal trapping from 1991 to 2001 give indications of diverse and healthy small mammal communities in the UWOEU. Preble's mouse monitoring has revealed abundance and species diversity of associated small mammals that would be expected in typical native riparian ecosystems on the plains of Colorado (Fitzgerald et al 1994). Additionally, less common riparian species include hispid pocket mouse (*Chaetodipus hispidus*), long-tailed vole (*Microtus longicaudus*) and water shrew (*Sorex palustris*). These species add to the diversity of the EU small mammal diversity. Water shrews were found in the Antelope Springs drainage and are indicative of good water quality and abundant aquatic macroinvertebrates.

The high species diversity and continued use of the site by numerous vertebrate species verifies that habitat quality for these species remains acceptable and the ecosystem functions are being maintained (K-H 2000). Data collected on wildlife abundance and diversity indicate that wildlife populations are stable and species richness remains high during remediation activities at RFETS, including wildlife using UWOEU.

## 10.3 General Uncertainty Analysis

Quantitative evaluation of ecological risks is limited by uncertainties regarding the assumptions used to predict risk and the data available for quantifying risk. These limitations are usually addressed by making estimates based on the data available or by making assumptions based on professional judgment when data are limited. Because of these assumptions and estimates, the results of the risk calculations themselves are uncertain, and it is important for risk managers and the public to view the results of the risk assessment with this in mind. Chemical-specific uncertainties are presented in Attachment 5 of this document and were discussed in terms of their potential effects on the risk characterization in the risk description section for each ECOPC. A full discussion of categories of general uncertainty that are not specific to the UWOEU are presented in Appendix A, Volume 2 of the RI/FS Report. The following sections are potential sources of general uncertainty that are specific to the UWOEU ERA.

### 10.3.1 Uncertainties Associated with Data Adequacy and Quality

Sections 1.2 and 1.3 summarize the general data adequacy and data quality for the UWOEU, respectively. A more detailed discussion is presented in Attachment 2 and Appendix A, Volume 2 of the RI/FS Report. The data adequacy assessment indicates that the data are adequate for the CRA. Data of sufficient quality for ERA purposes were collected in surface and subsurface soils.

### 10.3.2 Uncertainties Associated with the Lack of Toxicity Data for Ecological Contaminant of Interest Detected at the Upper Woman Drainage Exposure Unit

Several ECOIs detected in the UWOEU do not have adequate toxicity data for the derivation of ESLs (CRA Methodology). These ECOIs are listed in Tables 7.1, 7.3, and 7.12 with a "UT" designation. Appendix B of the CRA Methodology outlines a detailed search process that was intended to provide high-quality toxicological information for a large proportion of the chemicals detected at RFETS. Although the toxicity is uncertain for those ECOIs that do not have ESLs calculated due to a lack of identified toxicity data, the overall effect on the risk assessment is small because the primary chemicals historically used at RFETS have adequate toxicity data for use in the CRA. Therefore, while the potential for risk from these ECOPCs is uncertain and will tend to underestimate the overall risk calculated, the magnitude of underestimation is likely to be low.

ESLs and/or TRVs were not available for several of the ECOPC/receptor pairs identified in Section 7. These include antimony (birds), manganese (invertebrates), molybdenum (invertebrates), silver (invertebrates, birds and mammals), tin (invertebrates), uranium (invertebrates), vanadium (invertebrates), bis(2-ethylhexyl)phthalate (invertebrates), di-n-butylphthalate (invertebrates), total dioxin (plants and invertebrates), and total PCBs (invertebrates). The risks to these ECOPC/receptor pairs is uncertain. However, because risks to all of the ECOPCs mentioned above is considered to be low for those receptors where toxicity information is available, this source of uncertainty is not expected to be significant.

### 10.3.3 Uncertainties Associated with Eliminating Ecological Contaminants of Interest Based on Professional Judgment

Several analytes in surface soil and subsurface soil were eliminated as ECOIs based on professional judgment. The professional judgment evaluation is intended to identify those ECOIs that have a limited potential for contamination in the UWOEU. The weight-of-evidence approach indicates that there is no identified source or pattern of release in the UWOEU, and the slightly elevated values of the UWOEU data for these ECOIs are most likely due to natural variation. The professional judgment evaluation has little effect on the overall risk calculations because the ECOIs eliminated from further consideration are not related to site-activities in the UWOEU and have very low potential to be transported from historical sources to the UWOEU.

## 10.4 Summary of Significant Sources of Uncertainty

The preceding discussion outlined the significant sources of uncertainty in the CRA process for assessing ecological risk. While some of the general sources of uncertainty discussed tend to underestimate risk, an equal or greater number of uncertainties discussed for each ECOPC and in RI/FS Appendix A, Volume 2 indicate that risk estimations may be somewhat biased toward the overestimation of risk to a generally unknown degree.

# 11.0 SUMMARY AND CONCLUSIONS

A summary of the results of this CRA for human health and ecological receptors in the UWOEU is presented below.

## 11.1 Human Health

An HHRA was performed for the UWOEU for analytes identified as COCs. In the COC screening analyses, MDCs and UCLs of analytes in UWOEU media were compared to PRGs for the WRW receptor. Inorganic and radionuclide analytes with UCLs greater than the PRGs were statistically compared to the background concentration data set. Inorganic analytes that were statistically greater than background at the 0.1 significance level, and organics with UCL concentrations greater than the PRG were carried forward to professional judgment evaluation. Based on the COC selection process, benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) were retained as COCs for surface soil/surface sediment. No COCs were identified for subsurface soil. The estimated Tier 1 total excess lifetime cancer risk for potential exposure of the WRW to surface soil/surface sediment at the UWOEU is 8E-06 and the Tier 2 risk is 3E-06. The estimated total Tier 1 cancer risk for potential exposure of the WRV to surface soil/surface sediment based on the Tier 1 EPC is 9E-06, and the Tier 2 risk is 3E-06.

It is important to note that two locations, including those with the highest benzo(a)pyrene concentrations, are located underneath the Original Landfill cover. Exposure to soil at these locations is, therefore, not anticipated, and the benzo(a)pyrene concentration estimate for the UWOEU and the associated risk are likely overestimated. In addition, although selected as a COC for the HHRA, benzo(a)pyrene has not been directly associated with historical IHSSs, but could be associated with traffic, pavement degradation, or pavement operations within parts of the UWOEU or nearby IAEU. Polynuclear aromatic hydrocarbons (PAHs) are ubiquitous in the environment.

As part of the uncertainty analysis, the UCL was calculated for benzo(a)pyrene using only surface soil/surface sediment samples in the UWOEU that are located outside the Original Landfill cover. This UCL (334 μg/kg) is less than the PRG (379 μg/kg), therefore, benzo(a)pyrene would not be identified as a COC for the portion of UWOEU that is outside the Original Landfill cover. Accordingly, risks associated with exposure to benzo(a)pyrene in the UWOEU in areas outside the Original Landfill cover are less than 1E-06.

Exposure to the 2,3,7,8-TCDD (TEQ) in soil is also not anticipated because these samples are located approximately 20 feet bgs. These samples were taken as confirmation samples in an excavation following an accelerated action and, therefore, were classified as surface soil samples. However, the locations are actually approximately 20 feet bgs and not accessible by the WRW or WRV.

In summary, the risk characterization for exposure of the WRW and WRV to surface soil/surface sediment indicated that the estimated cancer risks for both receptor populations were within the $10^{-6}$ to $10^{-4}$ risk range. Noncancer risks were not estimated because noncancer toxicity criteria are not available for benzo(a)pyrene and 2,3,7,8-TCDD (TEQ).

## 11.2 Ecological Risk

No significant risks to survival, growth, and reproduction are predicted for the wildlife receptors evaluated in the UWOEU (see Table 11.1). ECOPCs in surface soil were identified for non-PMJM and PMJM receptors. ECOPCs for selected populations of non-PMJM receptors included antimony, copper, nickel, silver, tin, uranium, vanadium, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, total dioxin, and total PCBs. ECOPCs for individual PMJM receptors included antimony, chromium, copper, manganese, molybdenum, nickel, tin, vanadium, zinc, and total PCBs. No ECOPCs were identified in subsurface soil. The ECOPC/receptor pairs were evaluated in the risk characterization using a range of EPCs, exposure scenarios, and TRVs to give a range of risk estimates.

In addition, the high species diversity and continued use of the site by numerous vertebrate species verify that habitat quality for these species remains acceptable and the ecosystem functions are being maintained (K-H 2000). Data collected on wildlife abundance and diversity indicate that wildlife populations are stable and species richness remains high during remediation activities at RFETS, including wildlife using the UWOEU.

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# TABLES

Table 1.1
UWOEU IHSSs

| IHSS | PAC/UBC | Name | Description | Disposition |
|---|---|---|---|---|
| 102 | 800-102 | Oil Sludge Pit | The Oil Sludge Pit was a pit where drums of non-radioactive oil sludge were emptied in 1958. The sludge reportedly was collected during cleaning of two No. 6 fuel oil tanks (IHSS 105.1 and 105.2) south of Building 881. No action required. | OU 1 CAD/ROD |
| 106 | 800-106 | Bldg. 881, Outfall | At the Building 881Outfall Site there was a six-inch-diameter, vitrified-clay-pipe outfall, which existed south of Building 881 and discharged water until December 1977. The pipe was an overflow line from the sanitary sewer sump in Building 887. The pipe has been removed. No action required. | OU 1 CAD/ROD |
| 107 | 800-107 | Bldg. 881, Hillside Oil Leak | The Building 881 Hillside Oil Leak site was the location of an oil leak discovered in 1973 on the hillside south of Building 881. The oil spill was contained with straw, and the straw and soil were removed. No action required. | OU 1 CAD/ROD |
| 145 | 800-145 | Sanitary Waste Line Leak | In 1981, a portion of a six-inch, cast-iron sanitary sewer line located south of Building 881 leaked. The line conveyed sanitary wastes and did not carry hazardous or radioactive materials. The pipe has been removed. No action required. | OU 1 CAD/ROD |
| 115 | SW-115 | Original Landfill | The Original Landfill operated from 1952 to 1968 and was used to dispose of general wastes but potentially including solvents, paint thinners, paints, pesticides and depleted uranium. Depleted uranium "hot spots" were removed from the surface of the landfill, and the landfill was regraded and a soil cover placed on it as a final closure measure. | NFA-2005, HRR |
| 133.1 | SW-133.1 | Ash Pit 1 | Four ash pits, each about 8 feet by 3 feet by 150 feet, were used to dispose of the ash from the Plant incinerator, which burned general wastes and may have burned depleted uranium. Following the shutdown of the incinerator, the Ash Pits were covered with fill. No action required. | NFA-2003, HRR |
| 133.2 | SW-133.2 | Ash Pit 2 | Four ash pits, each about 8 feet by 3 feet by 150 feet, were used to dispose of the ash from the Plant incinerator, which burned general wastes and may have burned depleted uranium. Following the shutdown of the incinerator, the Ash Pits were covered with fill. No action required. | NFA-2003, HRR |
| 133.3 | SW-133.3 | Ash Pit 3 | Four ash pits, each about 8 feet by 3 feet by 150 feet, were used to dispose of the ash from the Plant incinerator, which burned general wastes and may have burned depleted uranium. Following the shutdown of the incinerator, the Ash Pits were covered with fill. No action required. | NFA-2002, HRR |
| 133.4 | SW-133.4 | Ash Pit 4 | Four ash pits, each about 8 feet by 3 feet by 150 feet, were used to dispose of the ash from the Plant incinerator, which burned general wastes and may have burned depleted uranium. Following the shutdown of the incinerator, the Ash Pits were covered with fill. No action required. | NFA-2003, HRR |

**Table 1.1**
**UWOEU IHSSs**

| IHSS | PAC/UBC | Name | Description | Disposition |
|---|---|---|---|---|
| 133.5 | SW-133.5 | Incinerator Facility | The incinerator was used to burn general RFETS' waste and possibly depleted uranium between the 1950s and 1968. The incinerator facility was removed per ER RSOP Notification #03-09 | NFA-2003, HRR |
| 133.6 | SW-133.6 | Concrete Wash Pad | This area was used to dispose of waste concrete from concrete trucks used during construction of plant facilities. It is also likely the trucks were washed down in this area after delivering concrete. 3000 cubic yards uncontaminated concrete were removed and recycled as a BMP. | NFA-2003, HRR |
| 196 | SW-196 | Water Treatment Plant Backwash Pond | During the early 1970s, backwash from the raw water treatment plant was collected in an unlined pond located on the south side of Building 124. Reportedly, the pond dried up and was destroyed in the late 1970s. This area was regraded and soil cover installed as part of IM/IRA for Original Landfill. | NFA-2005, HRR |
| N/A | SE-1600 | Pond 7-Steam Condensate Releases | Pond 7 was constructed in March 1955 as a retention pond for steam condensate releases from Building 881 and likely received other routine discharges from Building 881. Pond 7 was abandoned prior to October 1964. No action required. | NFA-2002, HRR |
| N/A | SE-1601.1 | Pond 8 - North [Original Pond 8] (Cooling Tower Discharge Releases) | Pond 8 North was constructed in March 1955 as a retention pond for cooling tower overflow and blowdown. Pond 8 North was abandoned prior to October 1964. No action required. | NFA-2002, HRR |
| N/A | SE-1601.2 | Pond 8 - South (Cooling Tower Discharge Releases) | Pond 8 South was constructed prior to October 1964 and appears to have been used as a retention pond both for the flows that formerly flowed into Ponds 7 and 8 North, which had both been abandoned by that date. No action required. | NFA-2002, HRR |
| N/A | SW-1700 | Fuel Spill into Woman Creek Drainage | An armored vehicle turned over into Woman Creek upstream of Pond C-1 on October 19, 1975. No action required. | NFA-2002, HRR |
| N/A | SW-1701 | Recently Identified Ash Pit (Also referred to as TDEM-1) | PAC SW-1701 is a suspected ash pit for disposing ash from the plant incinerator that operated prior to 1968. Drilling of the area turned up small shavings of metallic debris. No action required. | NFA-2002, HRR |
| N/A | SW-1702 | Recently Identified Ash Pit (Also referred to as TDEM-2) | PAC SW-1702 is a suspected ash pit for disposing ash from the plant incinerator that operated prior to 1968. Magnetometer surveys indicated buried metals at this location. The anomalies in both areas are similar. No action required. | NFA-2003, HRR |

**Table 1.2**
**Number of Samples in Each Medium by Analyte Suite**

| Analyte Suite | Surface Soil/ Surface Sediment[a] | SubSurface Soil/ Subsurface Sediment[a] | Surface Soil[b] | Surface Soil within PMJM[b] | Subsurface Soil[b] |
|---|---|---|---|---|---|
| Inorganics | 166 | 258 | 135 | 35 | 257 |
| Organics | 148 | 298 | 121 | 28 | 297 |
| Radionuclides | 217 | 252 | 177 | 45 | 251 |

[a] Used in the HHRA.

[b] Used in the ERA.

Note: The total number of results (analyses in Tables 1.3 through 1.7 may differ from the total number of samples presented in Table 1.2 because not all analyses are necessarily performed for each sample.

## Table 1.3
## Summary of Detected Analytes in Surface Soil/Surface Sediment

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)** | | | | | | | |
| Aluminum | 4.90 - 200 | 161 | 100 | 1,140 | 30,200 | 10,799 | 5,267 |
| Ammonia[b] | 0.300 - 0.300 | 5 | 60 | 0.684 | 4.40 | 1.90 | 2.14 |
| Antimony[b] | 0.280 - 60 | 148 | 8.78 | 0.330 | 51.3 | 5.68 | 8.25 |
| Arsenic | 0.120 - 10 | 161 | 98.8 | 0.290 | 27.9 | 5.07 | 3.05 |
| Barium | 0.370 - 200 | 161 | 100 | 14.6 | 464 | 123 | 59.1 |
| Beryllium | 0.0620 - 5 | 164 | 75 | 0.180 | 4.40 | 0.739 | 0.464 |
| Boron | 1 - 1.20 | 18 | 72.2 | 3.90 | 11 | 5.21 | 2.79 |
| Cadmium | 0.0650 - 5 | 148 | 31.8 | 0.270 | 30 | 0.796 | 2.50 |
| Calcium | 3.80 - 5,000 | 161 | 100 | 833 | 69,700 | 8,279 | 9,999 |
| Cesium | 2 - 1,000 | 124 | 11.3 | 2 | 16.4 | 8.63 | 15.3 |
| Chromium | 0.150 - 10 | 161 | 98.8 | 1.50 | 70.1 | 13.0 | 8.22 |
| Chromium VI | 0.00500 - 0.00500 | 4 | 25 | 0.0120 | 0.0120 | 0.00488 | 0.00475 |
| Cobalt | 0.180 - 50 | 160 | 88.1 | 2 | 13.7 | 7.23 | 2.53 |
| Copper | 0.0460 - 25 | 161 | 97.5 | 2.20 | 330 | 24.7 | 37.1 |
| Fluoride[b] | 2.50 - 2.50 | 4 | 25 | 20.3 | 20.3 | 5.93 | 9.58 |
| Iron | 0.890 - 100 | 161 | 100 | 2,660 | 38,800 | 14,077 | 5,227 |
| Lead | 0.170 - 6.60 | 166 | 100 | 2.60 | 220 | 26.3 | 22.8 |
| Lithium | 0.410 - 100 | 156 | 90.4 | 1.70 | 20 | 7.79 | 3.63 |
| Magnesium | 5.90 - 5,000 | 161 | 100 | 448 | 6,600 | 2,391 | 1,050 |
| Manganese | 0.170 - 15 | 161 | 100 | 45.2 | 829 | 258 | 116 |
| Mercury | 0.00280 - 0.339 | 157 | 40.1 | 0.0170 | 3.80 | 0.120 | 0.378 |
| Molybdenum | 0.290 - 200 | 158 | 19.0 | 0.310 | 11.7 | 1.42 | 1.48 |
| Nickel | 0.200 - 40 | 160 | 91.3 | 2.20 | 48 | 13.1 | 6.52 |
| Nitrate / Nitrite | 0.0200 - 7.40 | 33 | 72.7 | 0.414 | 32 | 2.92 | 5.59 |
| Potassium | 36 - 5,000 | 160 | 96.3 | 276 | 4,460 | 1,939 | 822 |
| Selenium | 0.210 - 5 | 146 | 34.9 | 0.220 | 3.80 | 0.335 | 0.366 |
| Silica[b] | 4.30 - 5.20 | 18 | 100 | 540 | 1,200 | 785 | 142 |
| Silicon[b] | 0 - 32.3 | 27 | 100 | 83.8 | 1,890 | 575 | 461 |
| Silver | 0.0780 - 10 | 145 | 23.4 | 0.0950 | 98 | 2.24 | 11.3 |
| Sodium | 5.27 - 5,000 | 159 | 79.2 | 36.6 | 2,060 | 137 | 198 |
| Strontium | 0.0590 - 400 | 160 | 99.4 | 4.80 | 150 | 38.8 | 28.3 |
| Thallium | 0.260 - 10 | 156 | 16.0 | 0.210 | 0.990 | 0.237 | 0.175 |
| Tin | 0.850 - 200 | 160 | 13.8 | 1.20 | 66.9 | 7.59 | 12.8 |
| Titanium | 0.0880 - 0.110 | 18 | 100 | 170 | 410 | 257 | 59.5 |
| Uranium | 1.40 - 1.70 | 18 | 38.9 | 1.80 | 85 | 8.60 | 20.1 |
| Vanadium | 0.470 - 50 | 161 | 100 | 4.90 | 68.6 | 29.6 | 10.5 |

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| Zinc | 0.458 - 20 | 161 | 100 | 10.6 | 2,080 | 93.0 | 197 |
| **Organics (mg/kg)** | | | | | | | |
| 1,2,3,4,6,7,8-HpCDF | 0 - 0.00269 | 10 | 90 | 2.35E-04 | 0.240 | 0.0349 | 0.0735 |
| 1,2,3,4,7,8,9-HpCDF | 0 - 0.00269 | 10 | 80 | 4.40E-04 | 0.0250 | 0.00366 | 0.00753 |
| 1,2,3,4,7,8-HxCDD | 0 - 0.00269 | 10 | 70 | 3.40E-04 | 0.00730 | 0.00140 | 0.00212 |
| 1,2,3,4,7,8-HxCDF | 0 - 0.00269 | 10 | 80 | 0.00120 | 0.140 | 0.0197 | 0.0429 |
| 1,2,3,6,7,8-HxCDD | 0 - 0.00269 | 10 | 80 | 4.10E-04 | 0.0120 | 0.00233 | 0.00342 |
| 1,2,3,6,7,8-HxCDF | 0 - 0.00269 | 10 | 80 | 4.40E-04 | 0.0430 | 0.00660 | 0.0131 |
| 1,2,3,7,8,9-HxCDD | 0 - 0.00269 | 10 | 90 | 2.20E-04 | 0.0210 | 0.00318 | 0.00630 |
| 1,2,3,7,8,9-HxCDF | 0 - 0.00269 | 10 | 40 | 1.90E-04 | 0.00250 | 6.55E-04 | 8.10E-04 |
| 1,2,3,7,8-PeCDF | 0 - 0.00269 | 10 | 80 | 2.90E-04 | 0.0280 | 0.00434 | 0.00843 |
| 1,2,4-Trichlorobenzene | 0.750 - 570 | 118 | 0.847 | 0.950 | 0.950 | 251 | 116 |
| 1,2,4-Trimethylbenzene | 1 - 5.79 | 8 | 12.5 | 1.50 | 1.50 | 0.957 | 0.874 |
| 2,3,4,6,7,8-HxCDF | 0 - 0.00269 | 10 | 80 | 5.50E-04 | 0.0630 | 0.00862 | 0.0192 |
| 2,3,4,7,8-PeCDF | 0 - 0.00269 | 10 | 80 | 6.40E-04 | 0.0560 | 0.00786 | 0.0170 |
| 2,3,7,8-TCDD | 0 - 0.00108 | 10 | 70 | 2.59E-05 | 0.00190 | 4.76E-04 | 5.38E-04 |
| 2,3,7,8-TCDF | 0 - 0.00108 | 10 | 80 | 8.70E-04 | 0.0280 | 0.00431 | 0.00842 |
| 2-Butanone | 4.90 - 116 | 34 | 14.7 | 3 | 380 | 23.4 | 69.0 |
| 2-Methylnaphthalene | 39 - 570 | 111 | 4.50 | 57 | 12,000 | 376 | 1,119 |
| 4,4'-DDT | 3.60 - 28 | 112 | 0.893 | 21 | 21 | 13.9 | 9.54 |
| 4-Methyl-2-pentanone | 4.10 - 57.9 | 32 | 3.13 | 4 | 4 | 7.15 | 4.45 |
| 4-Methylphenol | 63 - 570 | 79 | 2.53 | 68 | 510 | 224 | 79.0 |
| Acenaphthene | 51 - 1,200 | 124 | 16.9 | 51 | 44,000 | 671 | 3,932 |
| Acenaphthylene | 48 - 1,500 | 126 | 0.794 | 600 | 600 | 338 | 218 |
| Acetone | 4.80 - 116 | 36 | 33.3 | 5.80 | 890 | 57.9 | 159 |
| Aldrin[b] | 1.80 - 14 | 112 | 0.893 | 17 | 17 | 7.50 | 5.66 |
| Anthracene | 73 - 570 | 130 | 16.9 | 67 | 47,000 | 645 | 4,106 |
| Aroclor-1254 | 6.80 - 280 | 115 | 16.5 | 19 | 3,900 | 282 | 541 |
| Aroclor-1260 | 1.40 - 280 | 114 | 1.75 | 48 | 600 | 140 | 105 |
| Benzene[b] | 0.940 - 15 | 32 | 6.25 | 1.10 | 1.20 | 3.66 | 2.55 |
| Benzo(a)anthracene | 44 - 570 | 111 | 35.1 | 22 | 45,000 | 755 | 4,269 |
| Benzo(a)pyrene | 15 - 570 | 121 | 25.6 | 37 | 43,000 | 702 | 3,904 |
| Benzo(b)fluoranthene | 12 - 570 | 117 | 27.4 | 73 | 49,000 | 829 | 4,536 |
| Benzo(g,h,i)perylene | 46 - 570 | 104 | 19.2 | 45 | 28,000 | 513 | 2,740 |
| Benzo(k)fluoranthene | 77 - 570 | 111 | 18.0 | 59 | 25,000 | 533 | 2,355 |
| Benzoic Acid | 320 - 2,800 | 74 | 28.4 | 44 | 770 | 930 | 509 |
| Benzyl Alcohol | 92 - 570 | 68 | 1.47 | 270 | 270 | 239 | 114 |
| bis(2-ethylhexyl)phthalate | 79 - 1,200 | 113 | 31.9 | 48 | 3,500 | 285 | 396 |

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| Butylbenzylphthalate | 72 - 1,200 | 113 | 3.54 | 75 | 220 | 268 | 100 |
| Carbazole | 360 - 480 | 5 | 20 | 39 | 39 | 170 | 76.6 |
| Chrysene | 38 - 1,200 | 126 | 33.3 | 40 | 46,000 | 696 | 4,104 |
| Dibenz(a,h)anthracene | 20 - 570 | 104 | 4.81 | 60 | 9,200 | 329 | 889 |
| Dibenzofuran | 56 - 570 | 112 | 8.93 | 36 | 20,000 | 447 | 1,870 |
| Dieldrin | 3.60 - 28 | 112 | 0.893 | 34 | 34 | 14.2 | 9.76 |
| Diethylphthalate | 37 - 1,200 | 113 | 0.885 | 79 | 79 | 270 | 99.4 |
| Di-n-butylphthalate | 70 - 1,200 | 113 | 12.4 | 39 | 390 | 251 | 111 |
| Di-n-octylphthalate | 59 - 1,200 | 112 | 2.68 | 21 | 96 | 267 | 103 |
| Endosulfan sulfate | 3.60 - 28 | 112 | 0.893 | 24 | 24 | 13.9 | 9.56 |
| Endrin ketone[b] | 3.60 - 28 | 112 | 0.893 | 36 | 36 | 14.0 | 9.74 |
| Fluoranthene | 44 - 1,200 | 121 | 48.8 | 31 | 140,000 | 1,689 | 12,744 |
| Fluorene | 61 - 570 | 129 | 14.0 | 39 | 39,000 | 552 | 3,419 |
| Heptachlor epoxide | 1.80 - 14 | 112 | 0.893 | 10 | 10 | 7.08 | 4.93 |
| Heptachlorodibenzo-p-dioxin | 0 - 0.00269 | 10 | 90 | 2.48E-04 | 0.110 | 0.0221 | 0.0317 |
| Indeno(1,2,3-cd)pyrene | 29 - 570 | 106 | 17.9 | 24 | 32,000 | 575 | 3,097 |
| Isophorone | 52 - 570 | 112 | 0.893 | 96 | 96 | 269 | 100 |
| Methoxychlor[b] | 8 - 140 | 112 | 0.893 | 450 | 450 | 72.5 | 59.6 |
| Methylene Chloride | 0.840 - 41 | 36 | 27.8 | 0.950 | 220 | 14.5 | 41.2 |
| Naphthalene | 0.910 - 1,200 | 136 | 8.09 | 0.950 | 41,000 | 623 | 3,500 |
| OCDD | 0 - 0.00539 | 10 | 100 | 4.15E-04 | 0.390 | 0.120 | 0.111 |
| OCDF | 0 - 0.00539 | 10 | 100 | 7.19E-05 | 0.140 | 0.0223 | 0.0418 |
| Pentachlorodibenzo-p-dioxin[b] | 0 - 0.00269 | 10 | 70 | 3.20E-04 | 0.00710 | 0.00129 | 0.00208 |
| Phenanthrene | 46 - 1,200 | 131 | 39.7 | 24 | 170,000 | 1,750 | 14,855 |
| Phenol | 61 - 570 | 79 | 2.53 | 56 | 80 | 221 | 74.1 |
| Pyrene | 63 - 1,200 | 127 | 48.0 | 41 | 120,000 | 1,438 | 10,670 |
| Tetrachloroethene | 1 - 15 | 32 | 9.38 | 1 | 6 | 3.56 | 2.64 |
| Toluene | 0.820 - 15 | 34 | 20.6 | 2.90 | 310 | 12.9 | 52.5 |
| Trichloroethene | 0.920 - 34 | 33 | 3.03 | 23 | 23 | 4.19 | 4.25 |
| Xylene[b,c] | 2.90 - 15 | 32 | 6.25 | 2.90 | 5 | 3.92 | 2.36 |
| **Radionuclides (pCi/g)[d]** | | | | | | | |
| Americium-241 | 0 - 0.258 | 189 | N/A | -0.0288 | 0.802 | 0.0358 | 0.0727 |
| Cesium-134 | 0.0300 - 0.300 | 13 | N/A | 0.00100 | 0.300 | 0.0931 | 0.0913 |
| Cesium-137 | 0.0300 - 1 | 22 | N/A | 0.0300 | 1 | 0.173 | 0.201 |
| Gross Alpha | 1.70 - 56 | 126 | N/A | -6.30 | 320 | 21.1 | 31.2 |
| Gross Beta | 2 - 21 | 130 | N/A | 6.60 | 305 | 34.5 | 41.6 |
| Neptunium-237 | 0.00202 - 0.00483 | 2 | N/A | 0.00222 | 0.00224 | 0.00223 | 1.06E-05 |

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| Plutonium-238 | 0.00400 - 0.0369 | 14 | N/A | -0.00200 | 0.0253 | 0.00236 | 0.00671 |
| Plutonium-239/240 | 0 - 0.254 | 214 | N/A | -0.0126 | 17.1 | 0.230 | 1.23 |
| Radium-226 | 0.120 - 0.500 | 10 | N/A | 0.240 | 1.09 | 0.722 | 0.300 |
| Radium-228 | 0.0500 - 0.500 | 8 | N/A | 0.880 | 2.29 | 1.41 | 0.483 |
| Strontium-89/90 | 0.0200 - 0.990 | 20 | N/A | -0.0400 | 4.86 | 0.446 | 1.14 |
| Uranium-233/234 | 0 - 0.800 | 188 | N/A | 0.191 | 47.5 | 1.43 | 3.55 |
| Uranium-235 | 0 - 0.691 | 188 | N/A | -0.0230 | 2.24 | 0.0863 | 0.228 |
| Uranium-238 | 0 - 0.622 | 188 | N/A | 0.283 | 209 | 3.11 | 16.5 |

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[c] The value for total xylene is used.

[d] All radionuclide values are considered detects.

N/A = Not applicable.

**Table 1.4**
**Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment**

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)** | | | | | | | |
| Aluminum | 3.70 - 200 | 253 | 100 | 1,740 | 32,800 | 12,143 | 6,020 |
| Antimony | 0.0500 - 60 | 230 | 20.9 | 0.340 | 149 | 6.98 | 11.8 |
| Arsenic | 0.270 - 10 | 253 | 99.6 | 0.470 | 24.3 | 4.66 | 2.82 |
| Barium | 0.0200 - 200 | 253 | 100 | 21.5 | 1,610 | 160 | 141 |
| Beryllium | 0.0250 - 5 | 258 | 76.0 | 0.280 | 446 | 3.60 | 29.3 |
| Boron | 1 - 1.20 | 8 | 87.5 | 2.10 | 4.70 | 3.29 | 1.29 |
| Cadmium | 0.0650 - 5 | 247 | 16.6 | 0.0750 | 71 | 2.10 | 8.60 |
| Calcium | 1.80 - 5,000 | 253 | 99.6 | 1,140 | 60,000 | 7,340 | 7,307 |
| Cesium | 5 - 1,000 | 224 | 8.48 | 1.90 | 29.6 | 7.04 | 13.7 |
| Chromium | 0.150 - 10 | 253 | 99.6 | 4.30 | 8,310 | 52.8 | 522 |
| Cobalt | 0.0200 - 50 | 253 | 96.4 | 1.90 | 701 | 11.7 | 44.0 |
| Copper | 0.0460 - 25 | 253 | 96.8 | 3.60 | 8,850 | 140 | 760 |
| Iron | 1.10 - 100 | 253 | 100 | 2,340 | 107,000 | 18,370 | 14,237 |
| Lead | 0.160 - 20 | 258 | 100 | 2.90 | 5,200 | 60.7 | 343 |
| Lithium | 0.0740 - 100 | 250 | 87.6 | 1.40 | 29 | 8.69 | 5.33 |
| Magnesium | 0.100 - 5,000 | 253 | 100 | 392 | 9,480 | 3,096 | 1,484 |
| Manganese | 0.170 - 15 | 253 | 100 | 14.3 | 2,150 | 278 | 252 |
| Mercury | 0.00270 - 0.200 | 229 | 28.4 | 0.00620 | 1.40 | 0.0900 | 0.166 |
| Molybdenum | 0.290 - 200 | 252 | 23.8 | 0.320 | 470 | 5.06 | 33.1 |
| Nickel | 0.0200 - 40 | 253 | 96.4 | 2.70 | 4,750 | 40.2 | 298 |
| Phosphorus | N/A | 1 | 100 | 975 | 975 | 975 | N/A |
| Potassium | 10 - 5,000 | 252 | 91.7 | 327 | 4,190 | 1,426 | 727 |
| Selenium | 0.140 - 5 | 248 | 14.1 | 0.150 | 80.8 | 0.569 | 5.13 |
| Silica[b] | 4.40 - 5.20 | 8 | 100 | 550 | 850 | 703 | 105 |
| Silicon | 0 - 16.7 | 18 | 100 | 22.7 | 1,120 | 379 | 273 |
| Silver | 0.0780 - 25 | 235 | 17.9 | 0.230 | 311 | 7.11 | 31.9 |
| Sodium | 2.50 - 5,000 | 252 | 93.3 | 42 | 3,360 | 330 | 396 |
| Strontium | 0.0590 - 400 | 253 | 99.6 | 6.40 | 170 | 46.0 | 26.3 |
| Thallium | 0.100 - 29.3 | 252 | 27.8 | 0.210 | 6.30 | 0.304 | 0.998 |
| Tin | 0.850 - 200 | 252 | 8.73 | 1.50 | 579 | 8.71 | 38.7 |
| Titanium | 0.0880 - 0.100 | 9 | 100 | 34 | 283 | 155 | 78.4 |
| Total Petroleum Hydrocarbons | 17 - 30 | 29 | 6.90 | 21 | 62 | 12.7 | 9.93 |
| Uranium | 1.40 - 1.70 | 8 | 12.5 | 5.50 | 5.50 | 1.38 | 1.66 |
| Vanadium | 0.470 - 50 | 253 | 100 | 9.80 | 74.4 | 32.3 | 12.3 |
| Zinc | 0.460 - 20 | 253 | 100 | 7.60 | 6,920 | 137 | 509 |
| **Organics (ug/kg)** | | | | | | | |
| 1,1,1-Trichloroethane | 5 - 12 | 197 | 0.508 | 2 | 2 | 3.10 | 1.76 |

**Table 1.4**
**Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment**

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| 1,2,3,4,6,7,8-HpCDF | 0 | 1 | 100 | 0.00480 | 0.00480 | 0.00480 | N/A |
| 1,2,3,4,7,8,9-HpCDF[b] | 0 | 1 | 100 | 6.00E-04 | 6.00E-04 | 6.00E-04 | N/A |
| 1,2,3,4,7,8-HxCDD | 0 | 1 | 100 | 3.40E-04 | 3.40E-04 | 3.40E-04 | N/A |
| 1,2,3,4,7,8-HxCDF[b] | 0 | 1 | 100 | 0.00290 | 0.00290 | 0.00290 | N/A |
| 1,2,3,6,7,8-HxCDD[b] | 0 | 1 | 100 | 6.10E-04 | 6.10E-04 | 6.10E-04 | N/A |
| 1,2,3,6,7,8-HxCDF[b] | 0 | 1 | 100 | 0.00120 | 0.00120 | 0.00120 | N/A |
| 1,2,3,7,8,9-HxCDD[b] | 0 | 1 | 100 | 8.40E-04 | 8.40E-04 | 8.40E-04 | N/A |
| 1,2,3,7,8,9-HxCDF[b] | 0 | 1 | 100 | 1.40E-04 | 1.40E-04 | 1.40E-04 | N/A |
| 1,2,3,7,8-PeCDF[b] | 0 | 1 | 100 | 9.30E-04 | 9.30E-04 | 9.30E-04 | N/A |
| 1,2,4-Trichlorobenzene | 5.39 - 790 | 112 | 0.893 | 60 | 60 | 271 | 360 |
| 1,2-Dichlorobenzene | 5.39 - 790 | 112 | 0.893 | 30 | 30 | 271 | 360 |
| 1,3-Dichlorobenzene | 5.39 - 790 | 112 | 0.893 | 20 | 20 | 271 | 360 |
| 1,4-Dichlorobenzene[b] | 5.39 - 790 | 112 | 0.893 | 10 | 10 | 271 | 360 |
| 2,3,4,6,7,8-HxCDF[b] | 0 | 1 | 100 | 0.00120 | 0.00120 | 0.00120 | N/A |
| 2,3,4,7,8-PeCDF[b] | 0 | 1 | 100 | 0.00160 | 0.00160 | 0.00160 | N/A |
| 2,3,7,8-TCDD | 0 | 1 | 100 | 2.40E-04 | 2.40E-04 | 2.40E-04 | N/A |
| 2,3,7,8-TCDF | 0 | 1 | 100 | 0.00110 | 0.00110 | 0.00110 | N/A |
| 2-Butanone | 10 - 124 | 176 | 2.84 | 2 | 8 | 6.36 | 3.59 |
| 2-Chlorophenol | 10 - 790 | 108 | 0.926 | 10 | 10 | 296 | 359 |
| 2-Methylnaphthalene | 10 - 790 | 108 | 8.33 | 10 | 15,000 | 399 | 1,422 |
| 3,3'-Dichlorobenzidine | 20 - 1,600 | 107 | 0.935 | 160 | 160 | 587 | 702 |
| 4-Chloro-3-methylphenol | 10 - 790 | 108 | 0.926 | 10 | 10 | 310 | 371 |
| 4-Methyl-2-pentanone | 10 - 61.8 | 190 | 0.526 | 2 | 2 | 6.24 | 3.44 |
| Acenaphthene | 10 - 1,000 | 108 | 13.0 | 56 | 31,000 | 569 | 2,960 |
| Acenaphthylene | 10 - 1,000 | 108 | 0.926 | 47 | 47 | 292 | 359 |
| Acetone | 5 - 124 | 182 | 17.0 | 2 | 330 | 19.2 | 27.1 |
| alpha-BHC | 0.0500 - 18 | 100 | 1 | 15 | 15 | 6.32 | 2.54 |
| Anthracene | 10 - 1,000 | 108 | 13.0 | 61 | 46,000 | 738 | 4,403 |
| Aroclor-1254 | 1 - 370 | 99 | 10.1 | 210 | 960 | 172 | 162 |
| Aroclor-1260 | 1 - 370 | 100 | 3 | 450 | 1,300 | 148 | 151 |
| Benzo(a)anthracene | 10 - 1,000 | 108 | 16.7 | 44 | 48,000 | 810 | 4,610 |
| Benzo(a)pyrene | 10 - 790 | 108 | 15.7 | 10 | 43,000 | 751 | 4,127 |
| Benzo(b)fluoranthene | 10 - 1,000 | 106 | 17.0 | 53 | 48,000 | 818 | 4,648 |
| Benzo(g,h,i)perylene | 10 - 1,000 | 108 | 12.0 | 86 | 19,000 | 480 | 1,812 |
| Benzo(k)fluoranthene | 10 - 1,000 | 106 | 15.1 | 48 | 19,000 | 492 | 1,850 |
| Benzoic Acid | 50 - 3,800 | 103 | 17.5 | 42 | 260 | 1,275 | 1,827 |

**Table 1.4**
**Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment**

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| bis(2-ethylhexyl)phthalate | 10 - 790 | 108 | 19.4 | 42 | 540 | 279 | 367 |
| Bromoform | 5 - 12 | 194 | 0.515 | 2 | 2 | 3.10 | 1.77 |
| Butylbenzylphthalate | 10 - 790 | 108 | 4.63 | 50 | 1,400 | 322 | 389 |
| Chrysene | 10 - 1,000 | 108 | 16.7 | 52 | 53,000 | 864 | 5,093 |
| cis-1,2-Dichloroethene | 5.39 - 6.18 | 8 | 37.5 | 1.48 | 10.1 | 2.11 | 3.27 |
| Dibenz(a,h)anthracene | 10 - 1,000 | 108 | 7.41 | 53 | 890 | 305 | 363 |
| Dibenzofuran | 10 - 790 | 108 | 9.26 | 10 | 20,000 | 449 | 1,902 |
| Diethylphthalate | 10 - 790 | 108 | 1.85 | 40 | 250 | 297 | 359 |
| Di-n-butylphthalate | 10 - 2,500 | 108 | 10.2 | 88 | 2,700 | 319 | 429 |
| Di-n-octylphthalate | 10 - 1,000 | 108 | 1.85 | 39 | 50 | 298 | 360 |
| Fluoranthene | 10 - 790 | 108 | 21.3 | 10 | 160,000 | 2,036 | 15,396 |
| Fluorene | 10 - 1,000 | 108 | 13.0 | 42 | 35,000 | 610 | 3,344 |
| Heptachlor | 0.0500 - 18 | 100 | 1 | 3.10 | 3.10 | 6.16 | 2.40 |
| Heptachlor epoxide | 0.0500 - 18 | 100 | 1 | 11 | 11 | 6.28 | 2.43 |
| Heptachlorodibenzo-p-dioxin | 0 | 1 | 100 | 0.00960 | 0.00960 | 0.00960 | N/A |
| Hexachlorobenzene | 10 - 790 | 108 | 0.926 | 30 | 30 | 296 | 359 |
| Indeno(1,2,3-cd)pyrene | 10 - 1,000 | 108 | 10.2 | 98 | 22,000 | 518 | 2,099 |
| Isophorone | 10 - 1,000 | 108 | 0.926 | 82 | 82 | 299 | 359 |
| Methylene Chloride | 5 - 12 | 199 | 19.1 | 1 | 67 | 5.30 | 7.26 |
| Naphthalene | 5.39 - 790 | 112 | 8.04 | 30 | 61,000 | 803 | 5,741 |
| OCDD | 0 | 1 | 100 | 0.0750 | 0.0750 | 0.0750 | N/A |
| OCDF | 0 | 1 | 100 | 0.00620 | 0.00620 | 0.00620 | N/A |
| Pentachlorodibenzo-p-dioxin[b] | 0 | 1 | 100 | 3.50E-04 | 3.50E-04 | 3.50E-04 | N/A |
| Pentachlorophenol | 50 - 3,800 | 108 | 0.926 | 160 | 160 | 1,434 | 1,726 |
| Phenanthrene | 10 - 790 | 108 | 21.3 | 20 | 220,000 | 2,568 | 21,145 |
| Phenol | 10 - 790 | 108 | 3.70 | 30 | 140 | 293 | 360 |
| Pyrene | 10 - 790 | 108 | 21.3 | 10 | 150,000 | 1,894 | 14,426 |
| Tetrachloroethene | 5 - 12 | 199 | 10.1 | 1 | 920 | 16.5 | 84.1 |
| Toluene | 5 - 12 | 199 | 51.3 | 1 | 420 | 31.1 | 60.9 |
| Trichloroethene | 5 - 12 | 199 | 6.53 | 1 | 440 | 6.69 | 33.2 |
| **Radionuclides (pCi/g)[c]** | | | | | | | |
| Americium-241 | 0 - 0.850 | 237 | N/A | -0.0170 | 2.97 | 0.0311 | 0.200 |
| Cesium-134 | 0.0463 - 0.0533 | 3 | N/A | -0.103 | -0.0657 | -0.0839 | 0.0187 |
| Cesium-137 | 0.0410 - 0.140 | 23 | N/A | -0.0527 | 0.176 | 0.0194 | 0.0447 |
| Gross Alpha | 1.40 - 44.7 | 245 | N/A | 3.58 | 742 | 33.3 | 75.0 |
| Gross Beta | 1 - 291 | 245 | N/A | 7.50 | 1,580 | 54.8 | 141 |
| Plutonium-238 | 0.00393 - 0.234 | 25 | N/A | -0.00340 | 9.84 | 0.419 | 1.96 |

**Table 1.4**
**Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment**

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| Plutonium-239/240 | 0 - 2.48 | 244 | N/A | -0.00710 | 5.16 | 0.0835 | 0.413 |
| Radium-226 | 0.120 - 0.500 | 17 | N/A | 0.728 | 2.09 | 0.999 | 0.318 |
| Radium-228 | 0.190 - 0.740 | 26 | N/A | 0 | 2.79 | 1.55 | 0.577 |
| Strontium-89/90 | 0.0200 - 1 | 43 | N/A | -0.0144 | 0.969 | 0.249 | 0.254 |
| Uranium-233/234 | 0 - 5.76 | 245 | N/A | 0.0475 | 288 | 6.53 | 28.6 |
| Uranium-235 | 0 - 4.50 | 245 | N/A | -0.0193 | 37.7 | 0.710 | 3.90 |
| Uranium-238 | 0 - 3.94 | 245 | N/A | 0.238 | 1,160 | 24.5 | 136 |

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[c] All radionuclide values are considered detects.

N/A - Not available or not applicable.

Table 1.5
Summary of Detected Analytes in Surface Soil

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)** | | | | | | | |
| Aluminum | 4.90 - 200 | 130 | 100 | 1,950 | 30,000 | 11,069 | 4,969 |
| Ammonia | 0.300 - 0.300 | 5 | 60 | 0.684 | 4.40 | 1.90 | 2.14 |
| Antimony[b] | 0.280 - 60 | 120 | 6.67 | 0.330 | 49.8 | 4.53 | 5.84 |
| Arsenic | 0.810 - 10 | 130 | 100 | 0.290 | 10 | 5.06 | 2.11 |
| Barium | 0.370 - 200 | 130 | 100 | 40.1 | 464 | 122 | 51.2 |
| Beryllium | 0.0620 - 5 | 135 | 77.8 | 0.180 | 4.40 | 0.758 | 0.462 |
| Boron | 1 - 1.20 | 18 | 72.2 | 3.90 | 11 | 5.21 | 2.79 |
| Cadmium | 0.0650 - 5 | 120 | 30.8 | 0.270 | 30 | 0.777 | 2.76 |
| Calcium | 7 - 5,000 | 130 | 100 | 1,940 | 69,700 | 8,069 | 10,123 |
| Cesium | 200 - 1,000 | 96 | 10.4 | 2 | 16.4 | 4.52 | 2.91 |
| Chromium | 0.150 - 10 | 130 | 99.2 | 2.60 | 61 | 13.1 | 6.91 |
| Cobalt | 0.180 - 50 | 130 | 87.7 | 2.40 | 13.7 | 7.39 | 2.31 |
| Copper | 0.0460 - 25 | 130 | 99.2 | 5.10 | 330 | 24.6 | 36.3 |
| Iron | 1.40 - 100 | 130 | 100 | 4,700 | 29,000 | 14,052 | 3,987 |
| Lead | 0.170 - 3 | 135 | 100 | 5.80 | 220 | 26.4 | 22.7 |
| Lithium | 0.490 - 100 | 128 | 92.2 | 2.40 | 20 | 7.93 | 3.52 |
| Magnesium | 7.60 - 5,000 | 130 | 100 | 663 | 5,610 | 2,376 | 878 |
| Manganese | 0.170 - 15 | 130 | 100 | 45.2 | 829 | 261 | 112 |
| Mercury | 0.00280 - 0.200 | 128 | 46.9 | 0.0170 | 2.40 | 0.0905 | 0.217 |
| Molybdenum | 0.290 - 200 | 128 | 18.8 | 0.310 | 5.90 | 1.14 | 0.920 |
| Nickel | 0.200 - 40 | 129 | 96.1 | 4.70 | 48 | 13.2 | 5.71 |
| Nitrate / Nitrite | 0.200 - 0.200 | 7 | 100 | 0.414 | 3.63 | 1.93 | 1.12 |
| Potassium | 36 - 5,000 | 130 | 98.5 | 736 | 4,460 | 2,049 | 768 |
| Selenium | 0.800 - 5 | 120 | 35.8 | 0.220 | 1 | 0.283 | 0.194 |
| Silica[b] | 4.30 - 5.20 | 18 | 100 | 540 | 1,200 | 785 | 142 |
| Silicon[b] | 0 | 9 | 100 | 90.5 | 1,560 | 552 | 466 |
| Silver | 0.0780 - 10 | 117 | 23.9 | 0.0950 | 98 | 2.47 | 12.5 |
| Sodium | 130 - 5,000 | 130 | 75.4 | 48.4 | 474 | 102 | 81.7 |
| Strontium | 0.0590 - 200 | 129 | 100 | 11.8 | 150 | 36.1 | 24.5 |
| Thallium | 0.910 - 10 | 129 | 14.7 | 0.210 | 0.960 | 0.214 | 0.152 |
| Tin | 0.850 - 200 | 129 | 12.4 | 1.20 | 66.9 | 6.28 | 11.7 |
| Titanium | 0.0880 - 0.110 | 18 | 100 | 170 | 410 | 257 | 59.5 |
| Uranium | 1.40 - 1.70 | 18 | 38.9 | 1.80 | 85 | 8.60 | 20.1 |
| Vanadium | 0.470 - 50 | 130 | 100 | 9.90 | 54.8 | 30.7 | 8.87 |
| Zinc | 0.460 - 20 | 130 | 100 | 11.8 | 650 | 65.5 | 71.0 |

Table 1.5

Summary of Detected Analytes in Surface Soil

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| Organic (ug/kg) | | | | | | | |
| 1,2,3,4,6,7,8-HpCDF | 0 - 0.00269 | 10 | 90 | 2.35E-04 | 0.240 | 0.0349 | 0.0735 |
| 1,2,3,4,7,8,9-HpCDF | 0 - 0.00269 | 10 | 80 | 4.40E-04 | 0.0250 | 0.00366 | 0.00753 |
| 1,2,3,4,7,8-HxCDD | 0 - 0.00269 | 10 | 70 | 3.40E-04 | 0.00730 | 0.00140 | 0.00212 |
| 1,2,3,4,7,8-HxCDF | 0 - 0.00269 | 10 | 80 | 0.00120 | 0.140 | 0.0197 | 0.0429 |
| 1,2,3,6,7,8-HxCDD | 0 - 0.00269 | 10 | 80 | 4.10E-04 | 0.0120 | 0.00233 | 0.00342 |
| 1,2,3,6,7,8-HxCDF | 0 - 0.00269 | 10 | 80 | 4.40E-04 | 0.0430 | 0.00660 | 0.0131 |
| 1,2,3,7,8,9-HxCDD | 0 - 0.00269 | 10 | 90 | 2.20E-04 | 0.0210 | 0.00318 | 0.00630 |
| 1,2,3,7,8,9-HxCDF | 0 - 0.00269 | 10 | 40 | 1.90E-04 | 0.00250 | 6.55E-04 | 8.10E-04 |
| 1,2,3,7,8-PeCDF | 0 - 0.00269 | 10 | 80 | 2.90E-04 | 0.0280 | 0.00434 | 0.00843 |
| 1,2,4-Trichlorobenzene | 0.750 - 360 | 95 | 1.05 | 0.950 | 0.950 | 248 | 123 |
| 1,2,4-Trimethylbenzene | 1 - 5.79 | 8 | 12.5 | 1.50 | 1.50 | 0.957 | 0.874 |
| 2,3,4,6,7,8-HxCDF | 0 - 0.00269 | 10 | 80 | 5.50E-04 | 0.0630 | 0.00862 | 0.0192 |
| 2,3,4,7,8-PeCDF | 0 - 0.00269 | 10 | 80 | 6.40E-04 | 0.0560 | 0.00786 | 0.0170 |
| 2,3,7,8-TCDD | 0 - 0.00108 | 10 | 70 | 2.59E-05 | 0.00190 | 4.76E-04 | 5.38E-04 |
| 2,3,7,8-TCDF | 0 - 0.00108 | 10 | 80 | 8.70E-04 | 0.0280 | 0.00431 | 0.00842 |
| 2-Butanone | 4.90 - 116 | 11 | 9.09 | 3 | 3 | 8.21 | 7.18 |
| 2-Methylnaphthalene | 39 - 360 | 88 | 5.68 | 57 | 12,000 | 406 | 1,256 |
| 4,4'-DDT | 3.60 - 16 | 89 | 1.12 | 21 | 21 | 14.5 | 10.2 |
| 4-Methyl-2-pentanone | 4.10 - 57.9 | 11 | 9.09 | 4 | 4 | 7.38 | 7.59 |
| Acenaphthene | 51 - 1,200 | 101 | 20.8 | 51 | 44,000 | 765 | 4,355 |
| Acenaphthylene | 48 - 1,500 | 103 | 0.971 | 600 | 600 | 355 | 235 |
| Acetone | 4.80 - 116 | 11 | 18.2 | 5.80 | 11 | 14.9 | 15.8 |
| Aldrin[b] | 1.80 - 8 | 89 | 1.12 | 17 | 17 | 7.96 | 6.11 |
| Anthracene | 73 - 440 | 107 | 20.6 | 67 | 47,000 | 727 | 4,525 |
| Aroclor-1254 | 6.80 - 160 | 90 | 15.6 | 220 | 3,900 | 331 | 602 |
| Aroclor-1260 | 1.40 - 160 | 90 | 2.22 | 48 | 600 | 148 | 113 |
| Benzene[b] | 0.940 - 11 | 11 | 18.2 | 1.10 | 1.20 | 3.15 | 4.08 |
| Benzo(a)anthracene | 44 - 360 | 88 | 39.8 | 40 | 45,000 | 890 | 4,790 |
| Benzo(a)pyrene | 15 - 360 | 98 | 28.6 | 60 | 43,000 | 810 | 4,334 |
| Benzo(b)fluoranthene | 12 - 360 | 94 | 31.9 | 73 | 49,000 | 971 | 5,055 |
| Benzo(g,h,i)perylene | 46 - 360 | 81 | 22.2 | 50 | 28,000 | 588 | 3,104 |
| Benzo(k)fluoranthene | 77 - 360 | 88 | 20.5 | 59 | 25,000 | 609 | 2,642 |
| Benzoic Acid | 320 - 1,600 | 54 | 35.2 | 44 | 770 | 807 | 456 |
| Benzyl Alcohol | 92 - 330 | 48 | 2.08 | 270 | 270 | 225 | 120 |
| bis(2-ethylhexyl)phthalate | 79 - 360 | 89 | 27.0 | 48 | 3,500 | 273 | 367 |
| Butylbenzylphthalate | 72 - 360 | 89 | 2.25 | 120 | 220 | 273 | 102 |

**Table 1.5**
**Summary of Detected Analytes in Surface Soil**

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| Carbazole | 360 - 360 | 2 | 50 | 39 | 39 | 110 | 99.7 |
| Chrysene | 38 - 360 | 102 | 34.3 | 40 | 46,000 | 806 | 4,558 |
| Dibenz(a,h)anthracene | 20 - 360 | 81 | 6.17 | 60 | 9,200 | 348 | 1,007 |
| Dibenzofuran | 56 - 360 | 89 | 11.2 | 36 | 20,000 | 494 | 2,097 |
| Dieldrin | 3.60 - 16 | 89 | 1.12 | 34 | 34 | 14.9 | 10.5 |
| Di-n-butylphthalate | 70 - 360 | 89 | 11.2 | 40 | 200 | 250 | 111 |
| Di-n-octylphthalate | 59 - 360 | 88 | 1.14 | 83 | 83 | 271 | 102 |
| Endosulfan sulfate | 3.60 - 16 | 89 | 1.12 | 24 | 24 | 14.5 | 10.3 |
| Endrin ketone[b] | 3.60 - 16 | 89 | 1.12 | 36 | 36 | 14.7 | 10.5 |
| Fluoranthene | 44 - 360 | 97 | 50.5 | 49 | 140,000 | 2,052 | 14,224 |
| Fluorene | 61 - 360 | 106 | 17.0 | 39 | 39,000 | 614 | 3,771 |
| Heptachlor epoxide | 1.80 - 8 | 89 | 1.12 | 10 | 10 | 7.43 | 5.29 |
| Heptachlorodibenzo-p-dioxin | 0 - 0.00269 | 10 | 90 | 2.48E-04 | 0.110 | 0.0221 | 0.0317 |
| Indeno(1,2,3-cd)pyrene | 29 - 360 | 83 | 21.7 | 52 | 32,000 | 664 | 3,499 |
| Isophorone | 52 - 360 | 89 | 1.12 | 96 | 96 | 272 | 102 |
| Methoxychlor[b] | 8 - 80 | 89 | 1.12 | 450 | 450 | 76.4 | 64.9 |
| Methylene Chloride | 0.840 - 11 | 11 | 27.3 | 0.950 | 2 | 2.22 | 3.98 |
| Naphthalene | 0.910 - 1,200 | 113 | 9.73 | 0.950 | 41,000 | 696 | 3,839 |
| OCDD | 0 - 0.00539 | 10 | 100 | 4.15E-04 | 0.390 | 0.120 | 0.111 |
| OCDF | 0 - 0.00539 | 10 | 100 | 7.19E-05 | 0.140 | 0.0223 | 0.0418 |
| Pentachlorodibenzo-p-dioxin | 0 - 0.00269 | 10 | 70 | 3.20E-04 | 0.00710 | 0.00129 | 0.00208 |
| Phenanthrene | 46 - 430 | 107 | 41.1 | 43 | 170,000 | 2,095 | 16,431 |
| Phenol | 61 - 360 | 56 | 3.57 | 56 | 80 | 203 | 60.1 |
| Pyrene | 63 - 360 | 103 | 50.5 | 41 | 120,000 | 1,721 | 11,841 |
| Tetrachloroethene | 1 - 11 | 11 | 18.2 | 1 | 6 | 3.04 | 4.16 |
| Toluene | 0.820 - 11 | 11 | 36.4 | 2.90 | 310 | 30.7 | 92.6 |
| Xylene[b] | 2.90 - 11.6 | 11 | 9.09 | 2.90 | 2.90 | 3.66 | 3.77 |
| **Radionuclides (pCi/g)[c]** | | | | | | | |
| Americium-241 | 0 - 0.258 | 152 | N/A | -0.0288 | 0.802 | 0.0366 | 0.0763 |
| Cesium-137 | 1 - 1 | 1 | N/A | 1 | 1 | 1 | N/A |
| Gross Alpha | 1.70 - 20 | 95 | N/A | 1.47 | 113 | 19.0 | 17.6 |
| Gross Beta | 2 - 20 | 99 | N/A | 6.60 | 305 | 36.2 | 47.4 |
| Neptunium-237 | 0.00202 - 0.00483 | 2 | N/A | 0.00222 | 0.00224 | 0.00223 | 1.06E-05 |
| Plutonium-238 | 0.00400 - 0.0369 | 14 | N/A | -0.00200 | 0.0253 | 0.00236 | 0.00671 |
| Plutonium-239/240 | 0 - 0.254 | 175 | N/A | -0.0126 | 5.01 | 0.147 | 0.421 |
| Radium-226 | 0.500 - 0.500 | 4 | N/A | 0.813 | 1.09 | 0.962 | 0.115 |
| Radium-228 | 0.500 - 0.500 | 4 | N/A | 1.57 | 2.29 | 1.80 | 0.336 |

**Table 1.5**
**Summary of Detected Analytes in Surface Soil**

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| Uranium-233/234 | 0 - 0.800 | 154 | N/A | 0.191 | 47.5 | 1.49 | 3.90 |
| Uranium-235 | 0 - 0.691 | 154 | N/A | -0.0230 | 2.24 | 0.0920 | 0.250 |
| Uranium-238 | 0 - 0.622 | 154 | N/A | 0.283 | 209 | 3.54 | 18.2 |

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[c] All radionuclide values are considered detects.

N/A - Not applicable.

**Table 1.6**
**Summary of Detected Analytes in Surface Soil (PMJM Habitat)**

| Analyte | Range of Reported Detection Limits | Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)** | | | | | | | |
| Aluminum | 5.20 - 40 | 34 | 100 | 1,950 | 22,000 | 11,924 | 4,724 |
| Ammonia[b] | 0.300 - 0.300 | 3 | 66.7 | 4.06 | 4.40 | 2.88 | 2.35 |
| Antimony[b] | 0.300 - 12 | 29 | 13.8 | 0.330 | 49.8 | 7.06 | 10.8 |
| Arsenic | 0.860 - 2 | 34 | 100 | 1.90 | 9.90 | 5.25 | 1.60 |
| Barium | 0.390 - 40 | 34 | 100 | 40.1 | 209 | 135 | 36.5 |
| Beryllium | 0.0650 - 1 | 35 | 80 | 0.440 | 1.70 | 0.818 | 0.404 |
| Boron | 1.10 - 1.10 | 4 | 100 | 5.30 | 8.50 | 6.83 | 1.45 |
| Cadmium | 0.0690 - 1 | 32 | 34.4 | 0.420 | 4.10 | 0.734 | 0.834 |
| Calcium | 7.50 - 1,000 | 34 | 100 | 1,960 | 27,000 | 6,523 | 5,412 |
| Cesium | 200 - 200 | 26 | 19.2 | 2 | 16.4 | 5.72 | 3.97 |
| Chromium | 0.160 - 2 | 34 | 100 | 2.60 | 26 | 15.1 | 5.52 |
| Cobalt | 0.190 - 10 | 34 | 88.2 | 2.40 | 12.4 | 7.87 | 2.55 |
| Copper | 0.0480 - 5 | 34 | 100 | 5.10 | 112 | 26.4 | 25.5 |
| Iron | 1.50 - 20 | 34 | 100 | 4,700 | 23,400 | 15,750 | 4,233 |
| Lead | 0.170 - 1 | 35 | 100 | 12.8 | 40.2 | 27.5 | 8.03 |
| Lithium | 0.520 - 20 | 33 | 75.8 | 5.40 | 18.5 | 9.31 | 4.16 |
| Magnesium | 8 - 1,000 | 34 | 100 | 663 | 5,610 | 2,686 | 937 |
| Manganese | 0.180 - 3 | 34 | 100 | 134 | 829 | 319 | 141 |
| Mercury | 0.00730 - 0.100 | 33 | 57.6 | 0.0270 | 0.370 | 0.0924 | 0.0918 |
| Molybdenum | 0.310 - 40 | 33 | 18.2 | 0.840 | 4.40 | 1.18 | 0.784 |
| Nickel | 0.210 - 8 | 33 | 90.9 | 5.70 | 26.3 | 13.6 | 5.03 |
| Nitrate / Nitrite | 0.200 - 0.200 | 3 | 100 | 1.62 | 3.63 | 2.80 | 1.05 |
| Potassium | 38 - 1,000 | 34 | 100 | 781 | 4,460 | 2,470 | 891 |
| Selenium | 0.850 - 1 | 33 | 39.4 | 0.220 | 1 | 0.277 | 0.204 |
| Silica[b] | 4.60 - 4.70 | 4 | 100 | 540 | 1,200 | 835 | 274 |
| Silicon[b] | 0 - 0 | 4 | 100 | 90.5 | 798 | 584 | 331 |
| Silver | 0.0830 - 2 | 32 | 12.5 | 0.160 | 12.6 | 0.920 | 2.17 |
| Sodium | 140 - 1,000 | 34 | 70.6 | 52.6 | 403 | 93.5 | 66.1 |
| Strontium | 0.0620 - 40 | 34 | 100 | 14 | 94 | 40.1 | 18.2 |
| Thallium | 0.960 - 2 | 34 | 35.3 | 0.210 | 0.960 | 0.243 | 0.187 |
| Tin | 0.890 - 40 | 34 | 17.6 | 1.60 | 66.9 | 10.3 | 16.1 |
| Titanium[b] | 0.0930 - 0.0960 | 4 | 100 | 290 | 410 | 343 | 51.2 |
| Uranium | 1.50 - 1.50 | 4 | 50 | 9 | 26 | 9.13 | 11.9 |
| Vanadium[b] | 0.490 - 10 | 34 | 100 | 9.90 | 53 | 33.6 | 10.5 |
| Zinc | 0.480 - 4 | 34 | 100 | 21.2 | 199 | 73.4 | 41.1 |

**Table 1.6**
**Summary of Detected Analytes in Surface Soil (PMJM Habitat)**

| Analyte | Range of Reported Detection Limits | Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| **Organics (ug/kg)** | | | | | | | |
| Acenaphthene | 330 - 1,200 | 21 | 19.0 | 56 | 210 | 353 | 236 |
| Anthracene | 330 - 440 | 25 | 20 | 92 | 280 | 242 | 93.4 |
| Aroclor-1254 | 6.80 - 160 | 19 | 26.3 | 560 | 3,900 | 640 | 1,063 |
| Aroclor-1260 | 1.40 - 160 | 19 | 5.26 | 48 | 48 | 143 | 85.5 |
| Benzo(a)anthracene | 330 - 330 | 16 | 50 | 64 | 780 | 272 | 182 |
| Benzo(a)pyrene | 15 - 330 | 21 | 33.3 | 73 | 790 | 306 | 238 |
| Benzo(b)fluoranthene | 12 - 330 | 18 | 44.4 | 110 | 1,300 | 306 | 299 |
| Benzo(g,h,i)perylene | 50 - 330 | 24 | 8.33 | 69 | 83 | 189 | 155 |
| Benzo(k)fluoranthene | 330 - 330 | 16 | 18.8 | 59 | 150 | 269 | 128 |
| bis(2-ethylhexyl)phthalate | 330 - 330 | 16 | 37.5 | 66 | 210 | 211 | 127 |
| Butylbenzylphthalate | 330 - 330 | 16 | 6.25 | 220 | 220 | 284 | 110 |
| Chrysene | 100 - 330 | 22 | 36.4 | 68 | 820 | 215 | 192 |
| Di-n-butylphthalate | 330 - 330 | 16 | 6.25 | 40 | 40 | 274 | 125 |
| Fluoranthene | 140 - 330 | 20 | 60.0 | 110 | 2,100 | 407 | 482 |
| Fluorene | 140 - 330 | 24 | 16.7 | 39 | 160 | 183 | 127 |
| Indeno(1,2,3-cd)pyrene | 29 - 330 | 21 | 19.0 | 52 | 140 | 200 | 160 |
| Phenanthrene | 330 - 430 | 25 | 48 | 79 | 1,300 | 323 | 272 |
| Pyrene | 180 - 330 | 22 | 54.5 | 59 | 1,600 | 314 | 362 |
| **Radionuclides (pCi/g)[c]** | | | | | | | |
| Americium-241 | 0 - 0.188 | 42 | N/A | 6.00E-04 | 0.139 | 0.0290 | 0.0300 |
| Gross Alpha | 1.70 - 11.1 | 33 | N/A | 2.41 | 113 | 25.4 | 26.5 |
| Gross Beta | 2.20 - 5.20 | 36 | N/A | 6.60 | 305 | 52.9 | 74.8 |
| Plutonium-239/240 | 0 - 0.149 | 45 | N/A | 0.00230 | 1.31 | 0.121 | 0.232 |
| Uranium-233/234 | 0 - 0.583 | 40 | N/A | 0.408 | 47.5 | 2.58 | 7.31 |
| Uranium-235 | 0 - 0.562 | 40 | N/A | -0.0230 | 2.24 | 0.117 | 0.348 |
| Uranium-238 | 0 - 0.473 | 40 | N/A | 0.394 | 209 | 6.99 | 32.8 |

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[c] All radionuclide values are considered detects.

N/A - Not applicable.

**Table 1.7**
**Summary of Detected Analytes in Subsurface Soil**

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)** | | | | | | | |
| Aluminum | 3.70 - 200 | 252 | 100 | 1,740 | 32,800 | 12,169 | 6,017 |
| Antimony | 0.0500 - 60 | 229 | 21.0 | 0.340 | 149 | 7.00 | 11.9 |
| Arsenic | 0.270 - 10 | 252 | 99.6 | 0.470 | 24.3 | 4.68 | 2.82 |
| Barium | 0.0200 - 200 | 252 | 100 | 21.5 | 1,610 | 160 | 141 |
| Beryllium | 0.0250 - 5 | 257 | 76.3 | 0.280 | 446 | 3.61 | 29.3 |
| Boron | 1 - 1.20 | 8 | 87.5 | 2.10 | 4.70 | 3.29 | 1.29 |
| Cadmium | 0.0650 - 5 | 246 | 16.7 | 0.0750 | 71 | 2.11 | 8.62 |
| Calcium | 1.80 - 5,000 | 252 | 99.6 | 1,140 | 60,000 | 7,360 | 7,314 |
| Cesium | 5 - 1,000 | 223 | 8.52 | 1.90 | 29.6 | 6.60 | 12.1 |
| Chromium | 0.150 - 10 | 252 | 99.6 | 4.30 | 8,310 | 53.0 | 523 |
| Cobalt | 0.0200 - 50 | 252 | 96.4 | 1.90 | 701 | 11.7 | 44.0 |
| Copper | 0.0460 - 25 | 252 | 96.8 | 3.60 | 8,850 | 140 | 761 |
| Iron | 1.10 - 100 | 252 | 100 | 2,340 | 107,000 | 18,415 | 14,247 |
| Lead | 0.160 - 20 | 257 | 100 | 2.90 | 5,200 | 60.9 | 344 |
| Lithium | 0.0740 - 100 | 249 | 87.6 | 1.40 | 29 | 8.70 | 5.34 |
| Magnesium | 0.100 - 5,000 | 252 | 100 | 392 | 9,480 | 3,102 | 1,484 |
| Manganese | 0.170 - 15 | 252 | 100 | 14.3 | 2,150 | 279 | 253 |
| Mercury | 0.00270 - 0.200 | 228 | 28.5 | 0.00620 | 1.40 | 0.0901 | 0.167 |
| Molybdenum | 0.290 - 200 | 251 | 23.5 | 0.320 | 470 | 5.06 | 33.2 |
| Nickel | 0.0200 - 40 | 252 | 96.4 | 2.70 | 4,750 | 40.3 | 299 |
| Phosphorus | N/A | 1 | 100 | 975 | 975 | 975 | N/A |
| Potassium | 10 - 5,000 | 251 | 91.6 | 327 | 4,190 | 1,428 | 728 |
| Selenium | 0.140 - 5 | 247 | 13.8 | 0.150 | 80.8 | 0.569 | 5.15 |
| Silica[b] | 4.40 - 5.20 | 8 | 100 | 550 | 850 | 703 | 105 |
| Silicon | 0 - 12 | 17 | 100 | 22.7 | 1,120 | 392 | 276 |
| Silver | 0.0780 - 25 | 234 | 17.9 | 0.230 | 311 | 7.14 | 31.9 |
| Sodium | 2.50 - 5,000 | 251 | 93.2 | 42 | 3,360 | 331 | 397 |
| Strontium | 0.0590 - 400 | 252 | 99.6 | 6.40 | 170 | 46.1 | 26.3 |
| Thallium | 0.100 - 29.3 | 251 | 27.9 | 0.210 | 6.30 | 0.304 | 1.000 |
| Tin | 0.850 - 200 | 251 | 8.76 | 1.50 | 579 | 8.73 | 38.7 |
| Titanium | 0.0880 - 0.100 | 9 | 100 | 34 | 283 | 155 | 78.4 |
| Total Petroleum Hydrocarbons | 17 - 30 | 29 | 6.90 | 21 | 62 | 12.7 | 9.93 |
| Uranium | 1.40 - 1.70 | 8 | 12.5 | 5.50 | 5.50 | 1.38 | 1.66 |
| Vanadium | 0.470 - 50 | 252 | 100 | 9.80 | 74.4 | 32.3 | 12.3 |
| Zinc | 0.460 - 20 | 252 | 100 | 7.60 | 6,920 | 137 | 510 |

## Table 1.7
### Summary of Detected Analytes in Subsurface Soil

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| Organics[c] (ug/kg) | | | | | | | |
| 1,1,1-Trichloroethane | 5 - 6.30 | 196 | 0.510 | 2 | 2 | 3.09 | 1.75 |
| 1,2,4-Trichlorobenzene | 5.39 - 790 | 111 | 0.901 | 60 | 60 | 270 | 361 |
| 1,2-Dichlorobenzene | 5.39 - 790 | 111 | 0.901 | 30 | 30 | 270 | 361 |
| 1,3-Dichlorobenzene | 5.39 - 790 | 111 | 0.901 | 20 | 20 | 270 | 361 |
| 1,4-Dichlorobenzene[b] | 5.39 - 790 | 111 | 0.901 | 10 | 10 | 270 | 361 |
| 1,2,3,4,6,7,8-HpCDF | 0 - 0 | 1 | 100 | 0.00480 | 0.00480 | 0.00480 | N/A |
| 1,2,3,4,7,8,9-HpCDF[b] | 0 - 0 | 1 | 100 | 6.00E-04 | 6.00E-04 | 6.00E-04 | N/A |
| 1,2,3,4,7,8-HxCDD | 0 - 0 | 1 | 100 | 3.40E-04 | 3.40E-04 | 3.40E-04 | N/A |
| 1,2,3,4,7,8-HxCDF[b] | 0 - 0 | 1 | 100 | 0.00290 | 0.00290 | 0.00290 | N/A |
| 1,2,3,6,7,8-HxCDD | 0 - 0 | 1 | 100 | 6.10E-04 | 6.10E-04 | 6.10E-04 | N/A |
| 1,2,3,6,7,8-HxCDF[b] | 0 - 0 | 1 | 100 | 0.00120 | 0.00120 | 0.00120 | N/A |
| 1,2,3,7,8,9-HxCDD[b] | 0 - 0 | 1 | 100 | 8.40E-04 | 8.40E-04 | 8.40E-04 | N/A |
| 1,2,3,7,8,9-HxCDF[b] | 0 - 0 | 1 | 100 | 1.40E-04 | 1.40E-04 | 1.40E-04 | N/A |
| 12,3,7,8-PeCDF[b] | 0 - 0 | 1 | 100 | 9.30E-04 | 9.30E-04 | 9.30E-04 | N/A |
| 2,3,4,6,7,8-HxCDF[b] | 0 - 0 | 1 | 100 | 0.00120 | 0.00120 | 0.00120 | N/A |
| 2,3,4,7,8-PeCDF | 0 - 0 | 1 | 100 | 0.00160 | 0.00160 | 0.00160 | N/A |
| 2,3,7,8-TCDD[b] | 0 - 0 | 1 | 100 | 2.40E-04 | 2.40E-04 | 2.40E-04 | N/A |
| 2,3,7,8-TCDF | 0 - 0 | 1 | 100 | 0.00110 | 0.00110 | 0.00110 | N/A |
| 2-Butanone | 10 - 124 | 175 | 2.86 | 2 | 8 | 6.33 | 3.58 |
| 2-Chlorophenol | 10 - 790 | 107 | 0.935 | 10 | 10 | 295 | 361 |
| 2-Methylnaphthalene | 10 - 790 | 107 | 8.41 | 10 | 15,000 | 399 | 1,428 |
| 3,3'-Dichlorobenzidine | 20 - 1,600 | 106 | 0.943 | 160 | 160 | 585 | 705 |
| 4-Chloro-3-methylphenol | 10 - 790 | 107 | 0.935 | 10 | 10 | 309 | 372 |
| 4-Methyl-2-pentanone | 10 - 61.8 | 189 | 0.529 | 2 | 2 | 6.21 | 3.42 |
| Acenaphthene | 10 - 1,000 | 107 | 13.1 | 56 | 31,000 | 570 | 2,974 |
| Acenaphthylene | 10 - 1,000 | 107 | 0.935 | 47 | 47 | 291 | 361 |
| Acetone | 5 - 124 | 181 | 17.1 | 2 | 330 | 19.1 | 27.1 |
| alpha-BHC | 0.0500 - 8 | 99 | 1.01 | 15 | 15 | 6.29 | 2.54 |
| Anthracene | 10 - 1,000 | 107 | 13.1 | 61 | 46,000 | 742 | 4,423 |
| Aroclor-1254 | 1 - 160 | 98 | 10.2 | 210 | 960 | 172 | 162 |
| Aroclor-1260 | 1 - 160 | 99 | 3.03 | 450 | 1,300 | 147 | 152 |
| Benzo(a)anthracene | 10 - 1,000 | 107 | 16.8 | 44 | 48,000 | 813 | 4,632 |
| Benzo(a)pyrene | 10 - 790 | 107 | 15.9 | 10 | 43,000 | 754 | 4,146 |
| Benzo(b)fluoranthene | 10 - 1,000 | 105 | 17.1 | 53 | 48,000 | 822 | 4,670 |
| Benzo(g,h,i)perylene | 10 - 1,000 | 107 | 12.1 | 86 | 19,000 | 481 | 1,821 |

**Table 1.7**
**Summary of Detected Analytes in Subsurface Soil**

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| Benzo(k)fluoranthene | 10 - 1,000 | 105 | 15.2 | 48 | 19,000 | 493 | 1,859 |
| Benzoic Acid | 50 - 3,800 | 102 | 17.6 | 42 | 260 | 1,269 | 1,835 |
| bis(2-ethylhexyl)phthalate | 10 - 790 | 107 | 18.7 | 42 | 540 | 281 | 369 |
| Bromoform | 5 - 6.30 | 193 | 0.518 | 2 | 2 | 3.08 | 1.76 |
| Butylbenzylphthalate | 10 - 790 | 107 | 4.67 | 50 | 1,400 | 322 | 391 |
| Chrysene | 10 - 1,000 | 107 | 16.8 | 52 | 53,000 | 868 | 5,117 |
| cis-1,2-Dichloroethene | 5.39 - 6.18 | 8 | 37.5 | 1.48 | 10.1 | 2.11 | 3.27 |
| Dibenz(a,h)anthracene | 10 - 1,000 | 107 | 7.48 | 53 | 890 | 305 | 365 |
| Dibenzofuran | 10 - 790 | 107 | 9.35 | 10 | 20,000 | 449 | 1,911 |
| Diethylphthalate | 10 - 790 | 107 | 1.87 | 40 | 250 | 296 | 360 |
| Di-n-butylphthalate | 10 - 2,500 | 107 | 10.3 | 88 | 2,700 | 318 | 431 |
| Di-n-octylphthalate | 10 - 1,000 | 107 | 1.87 | 39 | 50 | 297 | 362 |
| Fluoranthene | 10 - 790 | 107 | 21.5 | 10 | 160,000 | 2,052 | 15,467 |
| Fluorene | 10 - 1,000 | 107 | 13.1 | 42 | 35,000 | 612 | 3,360 |
| Heptachlor epoxide | 0.0500 - 8 | 99 | 1.01 | 11 | 11 | 6.25 | 2.43 |
| Heptachlorodibenzo-p-dioxin | 0 - 0 | 1 | 100 | 0.00960 | 0.00960 | 0.00960 | |
| Hexachlorobenzene | 10 - 790 | 107 | 0.935 | 30 | 30 | 295 | 361 |
| Indeno(1,2,3-cd)pyrene | 10 - 1,000 | 107 | 10.3 | 98 | 22,000 | 519 | 2,109 |
| Isophorone | 10 - 1,000 | 107 | 0.935 | 82 | 82 | 299 | 361 |
| Methylene Chloride | 5 - 6.30 | 198 | 19.2 | 1 | 67 | 5.27 | 7.26 |
| Naphthalene | 5.39 - 790 | 111 | 8.11 | 30 | 61,000 | 807 | 5,767 |
| OCDD | 0 - 0 | 1 | 100 | 0.0750 | 0.0750 | 0.0750 | |
| OCDF | 0 - 0 | 1 | 100 | 0.00620 | 0.00620 | 0.00620 | |
| Pentachlorodibenzo-p-dioxin[b] | 0 - 0 | 1 | 100 | 3.50E-04 | 3.50E-04 | 3.50E-04 | |
| Pentachlorophenol | 50 - 3,800 | 107 | 0.935 | 160 | 160 | 1,430 | 1,733 |
| Phenanthrene | 10 - 790 | 107 | 21.5 | 20 | 220,000 | 2,589 | 21,243 |
| Phenol | 10 - 790 | 107 | 3.74 | 30 | 140 | 292 | 362 |
| Pyrene | 10 - 790 | 107 | 21.5 | 10 | 150,000 | 1,908 | 14,493 |
| Tetrachloroethene | 5 - 6.30 | 198 | 10.1 | 1 | 920 | 16.6 | 84.3 |
| Toluene | 5 - 6.30 | 198 | 51.5 | 1 | 420 | 31.3 | 61.0 |
| Trichloroethene | 5 - 6.30 | 198 | 6.57 | 1 | 440 | 6.69 | 33.3 |
| **Radionuclides (pCi/g)[c]** | | | | | | | |
| Americium-241 | 0 - 0.850 | 236 | N/A | -0.0170 | 2.97 | 0.0312 | 0.200 |
| Cesium-134 | 0.0463 - 0.0533 | 3 | N/A | -0.103 | -0.0657 | -0.0839 | 0.0187 |
| Cesium-137 | 0.0410 - 0.140 | 22 | N/A | -0.0527 | 0.0720 | 0.0123 | 0.0297 |
| Gross Alpha | 1.40 - 44.7 | 245 | N/A | 3.58 | 742 | 33.3 | 75.0 |
| Gross Beta | 1 - 291 | 244 | N/A | 7.50 | 1,580 | 54.8 | 142 |

**Table 1.7**
**Summary of Detected Analytes in Subsurface Soil**

| Analyte | Range of Reported Detection Limits | Total Number of Results | Detection Frequency (%) | Minimum Detected Concentration | Maximum Detected Concentration | Arithmetic Mean Concentration[a] | Standard Deviation[a] |
|---|---|---|---|---|---|---|---|
| Plutonium-238 | 0.00393 - 0.234 | 25 | N/A | -0.00340 | 9.84 | 0.419 | 1.96 |
| Plutonium-239/240 | 0 - 2.48 | 243 | N/A | -0.00710 | 5.16 | 0.0838 | 0.414 |
| Radium-226 | 0.120 - 0.500 | 17 | N/A | 0.728 | 2.09 | 0.999 | 0.318 |
| Radium-228 | 0.190 - 0.740 | 26 | N/A | 0 | 2.79 | 1.55 | 0.577 |
| Strontium-89/90 | 0.0200 - 1 | 42 | N/A | -0.0144 | 0.969 | 0.254 | 0.255 |
| Uranium-233/234 | 0 - 5.76 | 244 | N/A | 0.0475 | 288 | 6.54 | 28.6 |
| Uranium-235 | 0 - 4.50 | 244 | N/A | -0.0193 | 37.7 | 0.713 | 3.91 |
| Uranium-238 | 0 - 3.94 | 244 | N/A | 0.238 | 1,160 | 24.6 | 136 |

[a] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[b] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[c] All radionuclide values are considered detects.

N/A - Not available or not applicable.

Table 1.8

Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | TEF[a] | TEQ Concentration[b] |
|---|---|---|---|---|---|---|---|
| Surface Soil/Surface Sediment (ug/kg) | | | | | | | |
| BI31-008 | 03F0329-006 | 1,2,3,4,6,7,8-HpCDF | 0.00920 | Yes | V | 0.0100 | 9.20E-05 |
| BI31-008 | 03F0329-006 | 1,2,3,4,7,8-HxCDD | 5.00E-04 | Yes | JB | 0.100 | 5.00E-05 |
| BI31-008 | 03F0329-006 | 1,2,3,4,7,8-HxCDF | 0.00520 | Yes | V | 0.100 | 5.20E-04 |
| BI31-008 | 03F0329-006 | 1,2,3,4,7,8,9-HpCDF | 0.00120 | Yes | JB | 0.0100 | 1.20E-05 |
| BI31-008 | 03F0329-006 | 1,2,3,6,7,8-HxCDD | 0.00110 | Yes | JB | 0.100 | 1.10E-04 |
| BI31-008 | 03F0329-006 | 1,2,3,6,7,8-HxCDF | 0.00180 | Yes | JB | 0.100 | 1.80E-04 |
| BI31-008 | 03F0329-006 | 1,2,3,7,8-PeCDF | 0.00180 | Yes | JB | 0.0500 | 9.00E-05 |
| BI31-008 | 03F0329-006 | 1,2,3,7,8,9-HxCDD | 0.00120 | Yes | JB | 0.100 | 1.20E-04 |
| BI31-008 | 03F0329-006 | 1,2,3,7,8,9-HxCDF | 1.90E-04 | Yes | JB | 0.100 | 1.90E-05 |
| BI31-008 | 03F0329-006 | 2,3,4,6,7,8-HxCDF | 0.00200 | Yes | JB | 0.100 | 2.00E-04 |
| BI31-008 | 03F0329-006 | 2,3,4,7,8-PeCDF | 0.00330 | Yes | JB | 0.500 | 0.00165 |
| BI31-008 | 03F0329-006 | 2,3,7,8-TCDD | 3.80E-04 | Yes | V | 1 | 3.80E-04 |
| BI31-008 | 03F0329-006 | 2,3,7,8-TCDF | 0.00290 | Yes | V | 0.100 | 2.90E-04 |
| BI31-008 | 03F0329-006 | Heptachlorodibenzo-p-dioxin | 0.0170 | Yes | V | 0.0100 | 1.70E-04 |
| BI31-008 | 03F0329-006 | OCDD | 0.130 | Yes | V | 1.00E-04 | 1.30E-05 |
| BI31-008 | 03F0329-006 | OCDF | 0.0120 | Yes | V | 1.00E-04 | 1.20E-06 |
| BI31-008 | 03F0329-006 | Pentachlorodibenzo-p-dioxin | 4.00E-04 | Yes | JB | 1 | 4.00E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-006:** | | | | | | | **0.00430** |
| BI31-009-01 | 03F0329-004 | 1,2,3,4,6,7,8-HpCDF | 0.00260 | Yes | V | 0.0100 | 2.60E-05 |
| BI31-009-01 | 03F0329-004 | 1,2,3,4,7,8-HxCDD | 1.70E-04 | No | V | 0.100 | 0 |
| BI31-009-01 | 03F0329-004 | 1,2,3,4,7,8-HxCDF | 0.00120 | Yes | V | 0.100 | 1.20E-04 |
| BI31-009-01 | 03F0329-004 | 1,2,3,4,7,8,9-HpCDF | 4.40E-04 | Yes | JB | 0.0100 | 4.40E-06 |
| BI31-009-01 | 03F0329-004 | 1,2,3,6,7,8-HxCDD | 4.10E-04 | Yes | JB | 0.100 | 4.10E-05 |
| BI31-009-01 | 03F0329-004 | 1,2,3,6,7,8-HxCDF | 4.40E-04 | Yes | JB | 0.100 | 4.40E-05 |
| BI31-009-01 | 03F0329-004 | 1,2,3,7,8-PeCDF | 2.90E-04 | Yes | JB | 0.0500 | 1.45E-05 |
| BI31-009-01 | 03F0329-004 | 1,2,3,7,8,9-HxCDD | 3.90E-04 | Yes | JB | 0.100 | 3.90E-05 |
| BI31-009-01 | 03F0329-004 | 1,2,3,7,8,9-HxCDF | 1.10E-04 | No | V | 0.100 | 0 |
| BI31-009-01 | 03F0329-004 | 2,3,4,6,7,8-HxCDF | 5.50E-04 | Yes | JB | 0.100 | 5.50E-05 |
| BI31-009-01 | 03F0329-004 | 2,3,4,7,8-PeCDF | 6.40E-04 | Yes | JB | 0.500 | 3.20E-04 |
| BI31-009-01 | 03F0329-004 | 2,3,7,8-TCDD | 2.90E-04 | No | V | 1 | 0 |
| BI31-009-01 | 03F0329-004 | 2,3,7,8-TCDF | 8.70E-04 | Yes | V | 0.100 | 8.70E-05 |
| BI31-009-01 | 03F0329-004 | Heptachlorodibenzo-p-dioxin | 0.00680 | Yes | V | 0.0100 | 6.80E-05 |
| BI31-009-01 | 03F0329-004 | OCDD | 0.0540 | Yes | V | 1.00E-04 | 5.40E-06 |
| BI31-009-01 | 03F0329-004 | OCDF | 0.00450 | Yes | V | 1.00E-04 | 4.50E-07 |
| BI31-009-01 | 03F0329-004 | Pentachlorodibenzo-p-dioxin | 1.40E-04 | No | V | 1 | 0 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-004:** | | | | | | | **8.25E-04** |
| BI31-010 | 03F0329-002 | 1,2,3,4,6,7,8-HpCDF | 0.0510 | Yes | V | 0.0100 | 5.10E-04 |

## Table 1.8
### Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | TEF[a] | TEQ Concentration[b] |
|---|---|---|---|---|---|---|---|
| BI31-010 | 03F0329-002 | 1,2,3,4,7,8-HxCDD | 0.00120 | Yes | JB | 0.100 | 1.20E-04 |
| BI31-010 | 03F0329-002 | 1,2,3,4,7,8-HxCDF | 0.0270 | Yes | V | 0.100 | 0.00270 |
| BI31-010 | 03F0329-002 | 1,2,3,4,7,8,9-HpCDF | 0.00300 | Yes | V | 0.0100 | 3.00E-05 |
| BI31-010 | 03F0329-002 | 1,2,3,6,7,8-HxCDD | 0.00190 | Yes | V | 0.100 | 1.90E-04 |
| BI31-010 | 03F0329-002 | 1,2,3,6,7,8-HxCDF | 0.0100 | Yes | V | 0.100 | 0.00100 |
| BI31-010 | 03F0329-002 | 1,2,3,7,8-PeCDF | 0.00540 | Yes | V | 0.0500 | 2.70E-04 |
| BI31-010 | 03F0329-002 | 1,2,3,7,8,9-HxCDD | 0.00270 | Yes | V | 0.100 | 2.70E-04 |
| BI31-010 | 03F0329-002 | 1,2,3,7,8,9-HxCDF | 4.70E-04 | Yes | JB | 0.100 | 4.70E-05 |
| BI31-010 | 03F0329-002 | 2,3,4,6,7,8-HxCDF | 0.00810 | Yes | V | 0.100 | 8.10E-04 |
| BI31-010 | 03F0329-002 | 2,3,4,7,8-PeCDF | 0.00760 | Yes | V | 0.500 | 0.00380 |
| BI31-010 | 03F0329-002 | 2,3,7,8-TCDD | 2.30E-04 | Yes | V | 1 | 2.30E-04 |
| BI31-010 | 03F0329-002 | 2,3,7,8-TCDF | 0.00460 | Yes | V | 0.100 | 4.60E-04 |
| BI31-010 | 03F0329-002 | Heptachlorodibenzo-p-dioxin | 0.0160 | Yes | V | 0.0100 | 1.60E-04 |
| BI31-010 | 03F0329-002 | OCDD | 0.0900 | Yes | V | 1.00E-04 | 9.00E-06 |
| BI31-010 | 03F0329-002 | OCDF | 0.0200 | Yes | V | 1.00E-04 | 2.00E-06 |
| BI31-010 | 03F0329-002 | Pentachlorodibenzo-p-dioxin | 7.60E-04 | Yes | JB | 1 | 7.60E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-002:** | | | | | | | **0.0114** |
| BI31-011 | 03F0329-003 | 1,2,3,4,6,7,8-HpCDF | 0.240 | Yes | V | 0.0100 | 0.00240 |
| BI31-011 | 03F0329-003 | 1,2,3,4,7,8-HxCDD | 0.00730 | Yes | V | 0.100 | 7.30E-04 |
| BI31-011 | 03F0329-003 | 1,2,3,4,7,8-HxCDF | 0.140 | Yes | V | 0.100 | 0.0140 |
| BI31-011 | 03F0329-003 | 1,2,3,4,7,8,9-HpCDF | 0.0250 | Yes | V | 0.0100 | 2.50E-04 |
| BI31-011 | 03F0329-003 | 1,2,3,6,7,8-HxCDD | 0.0120 | Yes | V | 0.100 | 0.00120 |
| BI31-011 | 03F0329-003 | 1,2,3,6,7,8-HxCDF | 0.0430 | Yes | V | 0.100 | 0.00430 |
| BI31-011 | 03F0329-003 | 1,2,3,7,8-PeCDF | 0.0280 | Yes | V | 0.0500 | 0.00140 |
| BI31-011 | 03F0329-003 | 1,2,3,7,8,9-HxCDD | 0.0210 | Yes | V | 0.100 | 0.00210 |
| BI31-011 | 03F0329-003 | 1,2,3,7,8,9-HxCDF | 0.00250 | Yes | V | 0.100 | 2.50E-04 |
| BI31-011 | 03F0329-003 | 2,3,4,6,7,8-HxCDF | 0.0630 | Yes | V | 0.100 | 0.00630 |
| BI31-011 | 03F0329-003 | 2,3,4,7,8-PeCDF | 0.0560 | Yes | V | 0.500 | 0.0280 |
| BI31-011 | 03F0329-003 | 2,3,7,8-TCDD | 0.00190 | Yes | V | 1 | 0.00190 |
| BI31-011 | 03F0329-003 | 2,3,7,8-TCDF | 0.0280 | Yes | V | 0.100 | 0.00280 |
| BI31-011 | 03F0329-003 | Heptachlorodibenzo-p-dioxin | 0.110 | Yes | V | 0.0100 | 0.00110 |
| BI31-011 | 03F0329-003 | OCDD | 0.390 | Yes | V | 1.00E-04 | 3.90E-05 |
| BI31-011 | 03F0329-003 | OCDF | 0.140 | Yes | V | 1.00E-04 | 1.40E-05 |
| BI31-011 | 03F0329-003 | Pentachlorodibenzo-p-dioxin | 0.00710 | Yes | V | 1 | 0.00710 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-003:** | | | | | | | **0.0739** |
| BI31-012 | 03F2087-001 | 1,2,3,4,6,7,8-HpCDF | 0.00610 | Yes | V | 0.0100 | 6.10E-05 |
| BI31-012 | 03F2087-001 | 1,2,3,4,7,8-HxCDD | 3.40E-04 | Yes | V | 0.100 | 3.40E-05 |
| BI31-012 | 03F2087-001 | 1,2,3,4,7,8-HxCDF | 0.00270 | Yes | V | 0.100 | 2.70E-04 |

Table 1.8

Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | TEF[a] | TEQ Concentration[b] |
|---|---|---|---|---|---|---|---|
| BI31-012 | 03F2087-001 | 1,2,3,4,7,8,9-HpCDF | 8.80E-04 | Yes | V | 0.0100 | 8.80E-06 |
| BI31-012 | 03F2087-001 | 1,2,3,6,7,8-HxCDD | 0.00100 | Yes | V | 0.100 | 1.00E-04 |
| BI31-012 | 03F2087-001 | 1,2,3,6,7,8-HxCDF | 9.20E-04 | Yes | V | 0.100 | 9.20E-05 |
| BI31-012 | 03F2087-001 | 1,2,3,7,8-PeCDF | 6.20E-04 | Yes | V | 0.0500 | 3.10E-05 |
| BI31-012 | 03F2087-001 | 1,2,3,7,8,9-HxCDD | 0.00100 | Yes | V | 0.100 | 1.00E-04 |
| BI31-012 | 03F2087-001 | 1,2,3,7,8,9-HxCDF | 1.40E-04 | No | V | 0.100 | 0 |
| BI31-012 | 03F2087-001 | 2,3,4,6,7,8-HxCDF | 0.00120 | Yes | V | 0.100 | 1.20E-04 |
| BI31-012 | 03F2087-001 | 2,3,4,7,8-PeCDF | 0.00100 | Yes | V | 0.500 | 5.00E-04 |
| BI31-012 | 03F2087-001 | 2,3,7,8-TCDD | 5.50E-04 | Yes | V | 1 | 5.50E-04 |
| BI31-012 | 03F2087-001 | 2,3,7,8-TCDF | 0.00100 | Yes | V | 0.100 | 1.00E-04 |
| BI31-012 | 03F2087-001 | Heptachlorodibenzo-p-dioxin | 0.0150 | Yes | V | 0.0100 | 1.50E-04 |
| BI31-012 | 03F2087-001 | OCDD | 0.130 | Yes | V | 1.00E-04 | 1.30E-05 |
| BI31-012 | 03F2087-001 | OCDF | 0.0110 | Yes | V | 1.00E-04 | 1.10E-06 |
| BI31-012 | 03F2087-001 | Pentachlorodibenzo-p-dioxin | 3.20E-04 | Yes | V | 1 | 3.20E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-001:** | | | | | | | **0.00245** |
| BI31-013 | 03F2087-002 | 1,2,3,4,6,7,8-HpCDF | 0.0160 | Yes | V | 0.0100 | 1.60E-04 |
| BI31-013 | 03F2087-002 | 1,2,3,4,7,8-HxCDD | 5.90E-04 | Yes | V | 0.100 | 5.90E-05 |
| BI31-013 | 03F2087-002 | 1,2,3,4,7,8-HxCDF | 0.00850 | Yes | V | 0.100 | 8.50E-04 |
| BI31-013 | 03F2087-002 | 1,2,3,4,7,8,9-HpCDF | 0.00140 | Yes | V | 0.0100 | 1.40E-05 |
| BI31-013 | 03F2087-002 | 1,2,3,6,7,8-HxCDD | 0.00120 | Yes | V | 0.100 | 1.20E-04 |
| BI31-013 | 03F2087-002 | 1,2,3,6,7,8-HxCDF | 0.00330 | Yes | V | 0.100 | 3.30E-04 |
| BI31-013 | 03F2087-002 | 1,2,3,7,8-PeCDF | 0.00220 | Yes | V | 0.0500 | 1.10E-04 |
| BI31-013 | 03F2087-002 | 1,2,3,7,8,9-HxCDD | 0.00160 | Yes | V | 0.100 | 1.60E-04 |
| BI31-013 | 03F2087-002 | 1,2,3,7,8,9-HxCDF | 2.90E-04 | Yes | V | 0.100 | 2.90E-05 |
| BI31-013 | 03F2087-002 | 2,3,4,6,7,8-HxCDF | 0.00400 | Yes | V | 0.100 | 4.00E-04 |
| BI31-013 | 03F2087-002 | 2,3,4,7,8-PeCDF | 0.00370 | Yes | V | 0.500 | 0.00185 |
| BI31-013 | 03F2087-002 | 2,3,7,8-TCDD | 6.10E-04 | Yes | V | 1 | 6.10E-04 |
| BI31-013 | 03F2087-002 | 2,3,7,8-TCDF | 0.00220 | Yes | V | 0.100 | 2.20E-04 |
| BI31-013 | 03F2087-002 | Heptachlorodibenzo-p-dioxin | 0.0150 | Yes | V | 0.0100 | 1.50E-04 |
| BI31-013 | 03F2087-002 | OCDD | 0.0850 | Yes | V | 1.00E-04 | 8.50E-06 |
| BI31-013 | 03F2087-002 | OCDF | 0.0120 | Yes | V | 1.00E-04 | 1.20E-06 |
| BI31-013 | 03F2087-002 | Pentachlorodibenzo-p-dioxin | 5.60E-04 | Yes | V | 1 | 5.60E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-002:** | | | | | | | **0.00563** |
| BI31-015 | 04F0058-001 | 1,2,3,4,6,7,8-HpCDF | 0.00264 | No | V | 0.0100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,4,7,8-HxCDD | 0.00264 | No | V | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,4,7,8-HxCDF | 0.00264 | No | V | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,4,7,8,9-HpCDF | 0.00264 | No | V | 0.0100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,6,7,8-HxCDD | 0.00264 | No | V | 0.100 | 0 |

Table 1.8

Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | TEF[a] | TEQ Concentration[b] |
|---|---|---|---|---|---|---|---|
| BI31-015 | 04F0058-001 | 1,2,3,6,7,8-HxCDF | 0.00264 | No | V | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,7,8-PeCDF | 0.00264 | No | V | 0.0500 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,7,8,9-HxCDD | 0.00264 | No | V | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,7,8,9-HxCDF | 0.00264 | No | V | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 2,3,4,6,7,8-HxCDF | 0.00264 | No | V | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 2,3,4,7,8-PeCDF | 0.00264 | No | V | 0.500 | 0 |
| BI31-015 | 04F0058-001 | 2,3,7,8-TCDD | 0.00106 | No | V | 1 | 0 |
| BI31-015 | 04F0058-001 | 2,3,7,8-TCDF | 0.00106 | No | V | 0.100 | 0 |
| BI31-015 | 04F0058-001 | Heptachlorodibenzo-p-dioxin | 0.00264 | No | V | 0.0100 | 0 |
| BI31-015 | 04F0058-001 | OCDD | 4.15E-04 | Yes | JB | 1.00E-04 | 4.15E-08 |
| BI31-015 | 04F0058-001 | OCDF | 7.19E-05 | Yes | V | 1.00E-04 | 7.19E-09 |
| BI31-015 | 04F0058-001 | Pentachlorodibenzo-p-dioxin | 0.00264 | No | V | 1 | 0 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F0058-001:** | | | | | | | **4.87E-08** |
| BI31-016 | 04F0058-002 | 1,2,3,4,6,7,8-HpCDF | 2.35E-04 | Yes | V | 0.0100 | 2.35E-06 |
| BI31-016 | 04F0058-002 | 1,2,3,4,7,8-HxCDD | 0.00269 | No | V | 0.100 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,4,7,8-HxCDF | 0.00269 | No | V | 0.100 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,4,7,8,9-HpCDF | 0.00269 | No | V | 0.0100 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,6,7,8-HxCDD | 0.00269 | No | V | 0.100 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,6,7,8-HxCDF | 0.00269 | No | V | 0.100 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,7,8-PeCDF | 0.00269 | No | V | 0.0500 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,7,8,9-HxCDD | 2.20E-04 | Yes | V | 0.100 | 2.20E-05 |
| BI31-016 | 04F0058-002 | 1,2,3,7,8,9-HxCDF | 0.00269 | No | V | 0.100 | 0 |
| BI31-016 | 04F0058-002 | 2,3,4,6,7,8-HxCDF | 0.00269 | No | V | 0.100 | 0 |
| BI31-016 | 04F0058-002 | 2,3,4,7,8-PeCDF | 0.00269 | No | V | 0.500 | 0 |
| BI31-016 | 04F0058-002 | 2,3,7,8-TCDD | 2.59E-05 | Yes | V | 1 | 2.59E-05 |
| BI31-016 | 04F0058-002 | 2,3,7,8-TCDF | 0.00108 | No | V | 0.100 | 0 |
| BI31-016 | 04F0058-002 | Heptachlorodibenzo-p-dioxin | 2.48E-04 | Yes | V | 0.0100 | 2.48E-06 |
| BI31-016 | 04F0058-002 | OCDD | 0.00208 | Yes | JB | 1.00E-04 | 2.08E-07 |
| BI31-016 | 04F0058-002 | OCDF | 3.58E-04 | Yes | V | 1.00E-04 | 3.58E-08 |
| BI31-016 | 04F0058-002 | Pentachlorodibenzo-p-dioxin | 0.00269 | No | V | 1 | 0 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F0058-002:** | | | | | | | **5.30E-05** |
| BJ31-005 | 03F2087-004 | 1,2,3,4,6,7,8-HpCDF | 0.00990 | Yes | V | 0.0100 | 9.90E-05 |
| BJ31-005 | 03F2087-004 | 1,2,3,4,7,8-HxCDD | 7.20E-04 | Yes | V | 0.100 | 7.20E-05 |
| BJ31-005 | 03F2087-004 | 1,2,3,4,7,8-HxCDF | 0.00480 | Yes | V | 0.100 | 4.80E-04 |
| BJ31-005 | 03F2087-004 | 1,2,3,4,7,8,9-HpCDF | 7.10E-04 | Yes | V | 0.0100 | 7.10E-06 |
| BJ31-005 | 03F2087-004 | 1,2,3,6,7,8-HxCDD | 0.00140 | Yes | V | 0.100 | 1.40E-04 |
| BJ31-005 | 03F2087-004 | 1,2,3,6,7,8-HxCDF | 0.00180 | Yes | V | 0.100 | 1.80E-04 |
| BJ31-005 | 03F2087-004 | 1,2,3,7,8-PeCDF | 0.00110 | Yes | V | 0.0500 | 5.50E-05 |

**Table 1.8**

**Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors**

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | TEF[a] | TEQ Concentration[b] |
|---|---|---|---|---|---|---|---|
| BJ31-005 | 03F2087-004 | 1,2,3,7,8,9-HxCDD | 0.00120 | Yes | V | 0.100 | 1.20E-04 |
| BJ31-005 | 03F2087-004 | 1,2,3,7,8,9-HxCDF | 2.60E-04 | No | V | 0.100 | 0 |
| BJ31-005 | 03F2087-004 | 2,3,4,6,7,8-HxCDF | 0.00220 | Yes | V | 0.100 | 2.20E-04 |
| BJ31-005 | 03F2087-004 | 2,3,4,7,8-PeCDF | 0.00170 | Yes | V | 0.500 | 8.50E-04 |
| BJ31-005 | 03F2087-004 | 2,3,7,8-TCDD | 2.80E-04 | Yes | V | 1 | 2.80E-04 |
| BJ31-005 | 03F2087-004 | 2,3,7,8-TCDF | 0.00120 | Yes | V | 0.100 | 1.20E-04 |
| BJ31-005 | 03F2087-004 | Heptachlorodibenzo-p-dioxin | 0.0200 | Yes | V | 0.0100 | 2.00E-04 |
| BJ31-005 | 03F2087-004 | OCDD | 0.170 | Yes | J | 1.00E-04 | 1.70E-05 |
| BJ31-005 | 03F2087-004 | OCDF | 0.0110 | Yes | V | 1.00E-04 | 1.10E-06 |
| BJ31-005 | 03F2087-004 | Pentachlorodibenzo-p-dioxin | 4.50E-04 | Yes | V | 1 | 4.50E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-004:** | | | | | | | **0.00329** |
| BJ31-006 | 03F2087-005 | 1,2,3,4,6,7,8-HpCDF | 0.0130 | Yes | V | 0.0100 | 1.30E-04 |
| BJ31-006 | 03F2087-005 | 1,2,3,4,7,8-HxCDD | 5.50E-04 | Yes | V | 0.100 | 5.50E-05 |
| BJ31-006 | 03F2087-005 | 1,2,3,4,7,8-HxCDF | 0.00540 | Yes | V | 0.100 | 5.40E-04 |
| BJ31-006 | 03F2087-005 | 1,2,3,4,7,8,9-HpCDF | 0.00130 | Yes | V | 0.0100 | 1.30E-05 |
| BJ31-006 | 03F2087-005 | 1,2,3,6,7,8-HxCDD | 0.00160 | Yes | V | 0.100 | 1.60E-04 |
| BJ31-006 | 03F2087-005 | 1,2,3,6,7,8-HxCDF | 0.00210 | Yes | V | 0.100 | 2.10E-04 |
| BJ31-006 | 03F2087-005 | 1,2,3,7,8-PeCDF | 0.00130 | Yes | V | 0.0500 | 6.50E-05 |
| BJ31-006 | 03F2087-005 | 1,2,3,7,8,9-HxCDD | 0.00120 | Yes | V | 0.100 | 1.20E-04 |
| BJ31-006 | 03F2087-005 | 1,2,3,7,8,9-HxCDF | 3.60E-04 | No | V | 0.100 | 0 |
| BJ31-006 | 03F2087-005 | 2,3,4,6,7,8-HxCDF | 0.00250 | Yes | V | 0.100 | 2.50E-04 |
| BJ31-006 | 03F2087-005 | 2,3,4,7,8-PeCDF | 0.00200 | Yes | V | 0.500 | 0.00100 |
| BJ31-006 | 03F2087-005 | 2,3,7,8-TCDD | 2.20E-04 | No | V | 1 | 0 |
| BJ31-006 | 03F2087-005 | 2,3,7,8-TCDF | 0.00130 | Yes | V | 0.100 | 1.30E-04 |
| BJ31-006 | 03F2087-005 | Heptachlorodibenzo-p-dioxin | 0.0200 | Yes | V | 0.0100 | 2.00E-04 |
| BJ31-006 | 03F2087-005 | OCDD | 0.150 | Yes | J | 1.00E-04 | 1.50E-05 |
| BJ31-006 | 03F2087-005 | OCDF | 0.0120 | Yes | V | 1.00E-04 | 1.20E-06 |
| BJ31-006 | 03F2087-005 | Pentachlorodibenzo-p-dioxin | 6.20E-04 | Yes | V | 1 | 6.20E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-005:** | | | | | | | **0.00351** |
| **2,3,7,8-TCDD TEQ Concentration used in Surface Soil/Surface Sediment PRG Screen[c]:** | | | | | | | **0.0739** |
| | | | | | | | |
| **Subsurface Soil/Subsurface Sediment (ug/kg)** | | | | | | | |
| BI31-009 | 03F0329-005 | 1,2,3,4,6,7,8-HpCDF | 0.00480 | Yes | V | 0.0100 | 4.80E-05 |
| BI31-009 | 03F0329-005 | 1,2,3,4,7,8-HxCDD | 3.40E-04 | Yes | JB | 0.100 | 3.40E-05 |
| BI31-009 | 03F0329-005 | 1,2,3,4,7,8-HxCDF | 0.00290 | Yes | V | 0.100 | 2.90E-04 |
| BI31-009 | 03F0329-005 | 1,2,3,4,7,8,9-HpCDF | 6.00E-04 | Yes | JB | 0.0100 | 6.00E-06 |
| BI31-009 | 03F0329-005 | 1,2,3,6,7,8-HxCDD | 6.10E-04 | Yes | JB | 0.100 | 6.10E-05 |
| BI31-009 | 03F0329-005 | 1,2,3,6,7,8-HxCDF | 0.00120 | Yes | JB | 0.100 | 1.20E-04 |

**Table 1.8**

**Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors**

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | TEF[a] | TEQ Concentration[b] |
|---|---|---|---|---|---|---|---|
| BI31-009 | 03F0329-005 | 1,2,3,7,8-PeCDF | 9.30E-04 | Yes | JB | 0.0500 | 4.65E-05 |
| BI31-009 | 03F0329-005 | 1,2,3,7,8,9-HxCDD | 8.40E-04 | Yes | JB | 0.100 | 8.40E-05 |
| BI31-009 | 03F0329-005 | 1,2,3,7,8,9-HxCDF | 1.40E-04 | Yes | JB | 0.100 | 1.40E-05 |
| BI31-009 | 03F0329-005 | 2,3,4,6,7,8-HxCDF | 0.00120 | Yes | JB | 0.100 | 1.20E-04 |
| BI31-009 | 03F0329-005 | 2,3,4,7,8-PeCDF | 0.00160 | Yes | JB | 0.500 | 8.00E-04 |
| BI31-009 | 03F0329-005 | 2,3,7,8-TCDD | 2.40E-04 | Yes | V | 1 | 2.40E-04 |
| BI31-009 | 03F0329-005 | 2,3,7,8-TCDF | 0.00110 | Yes | V | 0.100 | 1.10E-04 |
| BI31-009 | 03F0329-005 | Heptachlorodibenzo-p-dioxin | 0.00960 | Yes | V | 0.0100 | 9.60E-05 |
| BI31-009 | 03F0329-005 | OCDD | 0.0750 | Yes | V | 1.00E-04 | 7.50E-06 |
| BI31-009 | 03F0329-005 | OCDF | 0.00620 | Yes | V | 1.00E-04 | 6.20E-07 |
| BI31-009 | 03F0329-005 | Pentachlorodibenzo-p-dioxin | 3.50E-04 | Yes | JB | 1 | 3.50E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-005:** | | | | | | | **0.00243** |
| **2,3,7,8-TCDD TEQ Concentration used in Subsurface Soil/Subsurface Sediment PRG Screen[c]:** | | | | | | | **0.00243** |

a : Toxicity Equivalency Factor (WHO, 1997).

b : TEQ (Toxicity Equivalence) concentration = Soil Concentration x TEF. For non-detects, the TEQ concentration equals zero.

[c] The 2,3,7,8-TCDD TEQ concentration used in the PRG screen is the maximum of all sampling locations for the medium.

Table 1.9

Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | Mammals TEF[a] | Mammals TEQ Concentration[b] | Birds TEF[a] | Birds TEQ Concentration[b] |
|---|---|---|---|---|---|---|---|---|---|
| **Surface Soil (ug/kg)** | | | | | | | | | |
| BI31-008 | 03F0329-006 | 1,2,3,4,6,7,8-HpCDF | 0.00920 | Yes | V | 0.0100 | 9.20E-05 | 0.0100 | 9.20E-05 |
| BI31-008 | 03F0329-006 | 1,2,3,4,7,8,9-HpCDF | 0.00120 | Yes | JB | 0.0100 | 1.20E-05 | 0.0100 | 1.20E-05 |
| BI31-008 | 03F0329-006 | 1,2,3,4,7,8-HxCDD | 5.00E-04 | Yes | JB | 0.100 | 5.00E-05 | 0.0500 | 2.50E-05 |
| BI31-008 | 03F0329-006 | 1,2,3,4,7,8-HxCDF | 0.00520 | Yes | V | 0.100 | 5.20E-04 | 0.100 | 5.20E-04 |
| BI31-008 | 03F0329-006 | 1,2,3,6,7,8-HxCDD | 0.00110 | Yes | JB | 0.100 | 1.10E-04 | 0.0100 | 1.10E-05 |
| BI31-008 | 03F0329-006 | 1,2,3,6,7,8-HxCDF | 0.00180 | Yes | JB | 0.100 | 1.80E-04 | 0.100 | 1.80E-04 |
| BI31-008 | 03F0329-006 | 1,2,3,7,8,9-HxCDD | 0.00120 | Yes | JB | 0.100 | 1.20E-04 | 0.100 | 1.20E-04 |
| BI31-008 | 03F0329-006 | 1,2,3,7,8,9-HxCDF | 1.90E-04 | Yes | JB | 0.100 | 1.90E-05 | 0.100 | 1.90E-05 |
| BI31-008 | 03F0329-006 | 1,2,3,7,8-PeCDF | 0.00180 | Yes | JB | 0.0500 | 9.00E-05 | 0.100 | 1.80E-04 |
| BI31-008 | 03F0329-006 | 2,3,4,6,7,8-HxCDF | 0.00200 | Yes | JB | 0.100 | 2.00E-04 | 0.100 | 2.00E-04 |
| BI31-008 | 03F0329-006 | 2,3,4,7,8-PeCDF | 0.00330 | Yes | JB | 0.500 | 0.00165 | 1 | 0.00330 |
| BI31-008 | 03F0329-006 | 2,3,7,8-TCDD | 3.80E-04 | Yes | V | 1 | 3.80E-04 | 1 | 3.80E-04 |
| BI31-008 | 03F0329-006 | 2,3,7,8-TCDF | 0.00290 | Yes | V | 0.100 | 2.90E-04 | 1 | 0.00290 |
| BI31-008 | 03F0329-006 | Heptachlorodibenzo-p-dioxin | 0.0170 | Yes | V | 0.0100 | 1.70E-04 | 0.00100 | 1.70E-05 |
| BI31-008 | 03F0329-006 | OCDD | 0.130 | Yes | V | 1.00E-04 | 1.30E-05 | 1.00E-04 | 1.30E-05 |
| BI31-008 | 03F0329-006 | OCDF | 0.0120 | Yes | V | 1.00E-04 | 1.20E-06 | 1.00E-04 | 1.20E-06 |
| BI31-008 | 03F0329-006 | Pentachlorodibenzo-p-dioxin | 4.00E-04 | Yes | JB | 1 | 4.00E-04 | 1 | 4.00E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-006:** | | | | | | | **0.00430** | | **0.00837** |
| BI31-009-01 | 03F0329-004 | 1,2,3,4,6,7,8-HpCDF | 0.00260 | Yes | V | 0.0100 | 2.60E-05 | 0.0100 | 2.60E-05 |
| BI31-009-01 | 03F0329-004 | 1,2,3,4,7,8,9-HpCDF | 4.40E-04 | Yes | JB | 0.0100 | 4.40E-06 | 0.0100 | 4.40E-06 |
| BI31-009-01 | 03F0329-004 | 1,2,3,4,7,8-HxCDD | 1.70E-04 | No | V | 0.100 | 0 | 0.0500 | 0 |
| BI31-009-01 | 03F0329-004 | 1,2,3,4,7,8-HxCDF | 0.00120 | Yes | V | 0.100 | 1.20E-04 | 0.100 | 1.20E-04 |
| BI31-009-01 | 03F0329-004 | 1,2,3,6,7,8-HxCDD | 4.10E-04 | Yes | JB | 0.100 | 4.10E-05 | 0.0100 | 4.10E-06 |
| BI31-009-01 | 03F0329-004 | 1,2,3,6,7,8-HxCDF | 4.40E-04 | Yes | JB | 0.100 | 4.40E-05 | 0.100 | 4.40E-05 |
| BI31-009-01 | 03F0329-004 | 1,2,3,7,8,9-HxCDD | 3.90E-04 | Yes | JB | 0.100 | 3.90E-05 | 0.100 | 3.90E-05 |
| BI31-009-01 | 03F0329-004 | 1,2,3,7,8,9-HxCDF | 1.10E-04 | No | V | 0.100 | 0 | 0.100 | 0 |
| BI31-009-01 | 03F0329-004 | 1,2,3,7,8-PeCDF | 2.90E-04 | Yes | JB | 0.0500 | 1.45E-05 | 0.100 | 2.90E-05 |
| BI31-009-01 | 03F0329-004 | 2,3,4,6,7,8-HxCDF | 5.50E-04 | Yes | JB | 0.100 | 5.50E-05 | 0.100 | 5.50E-05 |
| BI31-009-01 | 03F0329-004 | 2,3,4,7,8-PeCDF | 6.40E-04 | Yes | JB | 0.500 | 3.20E-04 | 1 | 6.40E-04 |
| BI31-009-01 | 03F0329-004 | 2,3,7,8-TCDD | 2.90E-04 | No | V | 1 | 0 | 1 | 0 |
| BI31-009-01 | 03F0329-004 | 2,3,7,8-TCDF | 8.70E-04 | Yes | V | 0.100 | 8.70E-05 | 1 | 8.70E-04 |
| BI31-009-01 | 03F0329-004 | Heptachlorodibenzo-p-dioxin | 0.00680 | Yes | V | 0.0100 | 6.80E-05 | 0.00100 | 6.80E-06 |
| BI31-009-01 | 03F0329-004 | OCDD | 0.0540 | Yes | V | 1.00E-04 | 5.40E-06 | 1.00E-04 | 5.40E-06 |
| BI31-009-01 | 03F0329-004 | OCDF | 0.00450 | Yes | V | 1.00E-04 | 4.50E-07 | 1.00E-04 | 4.50E-07 |
| BI31-009-01 | 03F0329-004 | Pentachlorodibenzo-p-dioxin | 1.40E-04 | No | V | 1 | 0 | 1 | 0 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-004:** | | | | | | | **8.25E-04** | | **0.00184** |

**Table 1.9**
**Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors**

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | Mammals TEF[a] | Mammals TEQ Concentration[b] | Birds TEF[a] | Birds TEQ Concentration[b] |
|---|---|---|---|---|---|---|---|---|---|
| BI31-010 | 03F0329-002 | 1,2,3,4,6,7,8-HpCDF | 0.0510 | Yes | V | 0.0100 | 5.10E-04 | 0.0100 | 5.10E-04 |
| BI31-010 | 03F0329-002 | 1,2,3,4,7,8,9-HpCDF | 0.00300 | Yes | V | 0.0100 | 3.00E-05 | 0.0100 | 3.00E-05 |
| BI31-010 | 03F0329-002 | 1,2,3,4,7,8-HxCDD | 0.00120 | Yes | JB | 0.100 | 1.20E-04 | 0.0500 | 6.00E-05 |
| BI31-010 | 03F0329-002 | 1,2,3,4,7,8-HxCDF | 0.0270 | Yes | V | 0.100 | 0.00270 | 0.100 | 0.00270 |
| BI31-010 | 03F0329-002 | 1,2,3,6,7,8-HxCDD | 0.00190 | Yes | V | 0.100 | 1.90E-04 | 0.0100 | 1.90E-05 |
| BI31-010 | 03F0329-002 | 1,2,3,6,7,8-HxCDF | 0.0100 | Yes | V | 0.100 | 0.00100 | 0.100 | 0.00100 |
| BI31-010 | 03F0329-002 | 1,2,3,7,8,9-HxCDD | 0.00270 | Yes | V | 0.100 | 2.70E-04 | 0.100 | 2.70E-04 |
| BI31-010 | 03F0329-002 | 1,2,3,7,8,9-HxCDF | 4.70E-04 | Yes | JB | 0.100 | 4.70E-05 | 0.100 | 4.70E-05 |
| BI31-010 | 03F0329-002 | 1,2,3,7,8-PeCDF | 0.00540 | Yes | V | 0.0500 | 2.70E-04 | 0.100 | 5.40E-04 |
| BI31-010 | 03F0329-002 | 2,3,4,6,7,8-HxCDF | 0.00810 | Yes | V | 0.100 | 8.10E-04 | 0.100 | 8.10E-04 |
| BI31-010 | 03F0329-002 | 2,3,4,7,8-PeCDF | 0.00760 | Yes | V | 0.500 | 0.00380 | 1 | 0.00760 |
| BI31-010 | 03F0329-002 | 2,3,7,8-TCDD | 2.30E-04 | Yes | V | 1 | 2.30E-04 | 1 | 2.30E-04 |
| BI31-010 | 03F0329-002 | 2,3,7,8-TCDF | 0.00460 | Yes | V | 0.100 | 4.60E-04 | 1 | 0.00460 |
| BI31-010 | 03F0329-002 | Heptachlorodibenzo-p-dioxin | 0.0160 | Yes | V | 0.0100 | 1.60E-04 | 0.00100 | 1.60E-05 |
| BI31-010 | 03F0329-002 | OCDD | 0.0900 | Yes | V | 1.00E-04 | 9.00E-06 | 1.00E-04 | 9.00E-06 |
| BI31-010 | 03F0329-002 | OCDF | 0.0200 | Yes | V | 1.00E-04 | 2.00E-06 | 1.00E-04 | 2.00E-06 |
| BI31-010 | 03F0329-002 | Pentachlorodibenzo-p-dioxin | 7.60E-04 | Yes | JB | 1 | 7.60E-04 | 1 | 7.60E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-002:** | | | | | | | **0.0114** | | **0.0192** |
| BI31-011 | 03F0329-003 | 1,2,3,4,6,7,8-HpCDF | 0.240 | Yes | V | 0.0100 | 0.00240 | 0.0100 | 0.00240 |
| BI31-011 | 03F0329-003 | 1,2,3,4,7,8,9-HpCDF | 0.0250 | Yes | V | 0.0100 | 2.50E-04 | 0.0100 | 2.50E-04 |
| BI31-011 | 03F0329-003 | 1,2,3,4,7,8-HxCDD | 0.00730 | Yes | V | 0.100 | 7.30E-04 | 0.0500 | 3.65E-04 |
| BI31-011 | 03F0329-003 | 1,2,3,4,7,8-HxCDF | 0.140 | Yes | V | 0.100 | 0.0140 | 0.100 | 0.0140 |
| BI31-011 | 03F0329-003 | 1,2,3,6,7,8-HxCDD | 0.0120 | Yes | V | 0.100 | 0.00120 | 0.0100 | 1.20E-04 |
| BI31-011 | 03F0329-003 | 1,2,3,6,7,8-HxCDF | 0.0430 | Yes | V | 0.100 | 0.00430 | 0.100 | 0.00430 |
| BI31-011 | 03F0329-003 | 1,2,3,7,8,9-HxCDD | 0.0210 | Yes | V | 0.100 | 0.00210 | 0.100 | 0.00210 |
| BI31-011 | 03F0329-003 | 1,2,3,7,8,9-HxCDF | 0.00250 | Yes | V | 0.100 | 2.50E-04 | 0.100 | 2.50E-04 |
| BI31-011 | 03F0329-003 | 1,2,3,7,8-PeCDF | 0.0280 | Yes | V | 0.0500 | 0.00140 | 0.100 | 0.00280 |
| BI31-011 | 03F0329-003 | 2,3,4,6,7,8-HxCDF | 0.0630 | Yes | V | 0.100 | 0.00630 | 0.100 | 0.00630 |
| BI31-011 | 03F0329-003 | 2,3,4,7,8-PeCDF | 0.0560 | Yes | V | 0.500 | 0.0280 | 1 | 0.0560 |
| BI31-011 | 03F0329-003 | 2,3,7,8-TCDD | 0.00190 | Yes | V | 1 | 0.00190 | 1 | 0.00190 |
| BI31-011 | 03F0329-003 | 2,3,7,8-TCDF | 0.0280 | Yes | V | 0.100 | 0.00280 | 1 | 0.0280 |
| BI31-011 | 03F0329-003 | Heptachlorodibenzo-p-dioxin | 0.110 | Yes | V | 0.0100 | 0.00110 | 0.00100 | 1.10E-04 |
| BI31-011 | 03F0329-003 | OCDD | 0.390 | Yes | V | 1.00E-04 | 3.90E-05 | 1.00E-04 | 3.90E-05 |
| BI31-011 | 03F0329-003 | OCDF | 0.140 | Yes | V | 1.00E-04 | 1.40E-05 | 1.00E-04 | 1.40E-05 |
| BI31-011 | 03F0329-003 | Pentachlorodibenzo-p-dioxin | 0.00710 | Yes | V | 1 | 0.00710 | 1 | 0.00710 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-003:** | | | | | | | **0.0739** | | **0.126** |
| BI31-012 | 03F2087-001 | 1,2,3,4,6,7,8-HpCDF | 0.00610 | Yes | V1 | 0.0100 | 6.10E-05 | 0.0100 | 6.10E-05 |

Table 1.9

Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | Mammals TEF[a] | Mammals TEQ Concentration[b] | Birds TEF[a] | Birds TEQ Concentration[b] |
|---|---|---|---|---|---|---|---|---|---|
| BI31-012 | 03F2087-001 | 1,2,3,4,7,8,9-HpCDF | 8.80E-04 | Yes | V1 | 0.0100 | 8.80E-06 | 0.0100 | 8.80E-06 |
| BI31-012 | 03F2087-001 | 1,2,3,4,7,8-HxCDD | 3.40E-04 | Yes | V1 | 0.100 | 3.40E-05 | 0.0500 | 1.70E-05 |
| BI31-012 | 03F2087-001 | 1,2,3,4,7,8-HxCDF | 0.00270 | Yes | V1 | 0.100 | 2.70E-04 | 0.100 | 2.70E-04 |
| BI31-012 | 03F2087-001 | 1,2,3,6,7,8-HxCDD | 0.00100 | Yes | V1 | 0.100 | 1.00E-04 | 0.0100 | 1.00E-05 |
| BI31-012 | 03F2087-001 | 1,2,3,6,7,8-HxCDF | 9.20E-04 | Yes | V1 | 0.100 | 9.20E-05 | 0.100 | 9.20E-05 |
| BI31-012 | 03F2087-001 | 1,2,3,7,8,9-HxCDD | 0.00100 | Yes | V1 | 0.100 | 1.00E-04 | 0.100 | 1.00E-04 |
| BI31-012 | 03F2087-001 | 1,2,3,7,8,9-HxCDF | 1.40E-04 | No | V1 | 0.100 | 0 | 0.100 | 0 |
| BI31-012 | 03F2087-001 | 1,2,3,7,8-PeCDF | 6.20E-04 | Yes | V1 | 0.0500 | 3.10E-05 | 0.100 | 6.20E-05 |
| BI31-012 | 03F2087-001 | 2,3,4,6,7,8-HxCDF | 0.00120 | Yes | V1 | 0.100 | 1.20E-04 | 0.100 | 1.20E-04 |
| BI31-012 | 03F2087-001 | 2,3,4,7,8-PeCDF | 0.00100 | Yes | V1 | 0.500 | 5.00E-04 | 1 | 0.00100 |
| BI31-012 | 03F2087-001 | 2,3,7,8-TCDD | 5.50E-04 | Yes | V1 | 1 | 5.50E-04 | 1 | 5.50E-04 |
| BI31-012 | 03F2087-001 | 2,3,7,8-TCDF | 0.00100 | Yes | V1 | 0.100 | 1.00E-04 | 1 | 0.00100 |
| BI31-012 | 03F2087-001 | Heptachlorodibenzo-p-dioxin | 0.0150 | Yes | V1 | 0.0100 | 1.50E-04 | 0.00100 | 1.50E-05 |
| BI31-012 | 03F2087-001 | OCDD | 0.130 | Yes | V1 | 1.00E-04 | 1.30E-05 | 1.00E-04 | 1.30E-05 |
| BI31-012 | 03F2087-001 | OCDF | 0.0110 | Yes | V1 | 1.00E-04 | 1.10E-06 | 1.00E-04 | 1.10E-06 |
| BI31-012 | 03F2087-001 | Pentachlorodibenzo-p-dioxin | 3.20E-04 | Yes | V1 | 1 | 3.20E-04 | 1 | 3.20E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-001:** | | | | | | | **0.00245** | | **0.00364** |
| BI31-013 | 03F2087-002 | 1,2,3,4,6,7,8-HpCDF | 0.0160 | Yes | V1 | 0.0100 | 1.60E-04 | 0.0100 | 1.60E-04 |
| BI31-013 | 03F2087-002 | 1,2,3,4,7,8,9-HpCDF | 0.00140 | Yes | V1 | 0.0100 | 1.40E-05 | 0.0100 | 1.40E-05 |
| BI31-013 | 03F2087-002 | 1,2,3,4,7,8-HxCDD | 5.90E-04 | Yes | V1 | 0.100 | 5.90E-05 | 0.0500 | 2.95E-05 |
| BI31-013 | 03F2087-002 | 1,2,3,4,7,8-HxCDF | 0.00850 | Yes | V1 | 0.100 | 8.50E-04 | 0.100 | 8.50E-04 |
| BI31-013 | 03F2087-002 | 1,2,3,6,7,8-HxCDD | 0.00120 | Yes | V1 | 0.100 | 1.20E-04 | 0.0100 | 1.20E-05 |
| BI31-013 | 03F2087-002 | 1,2,3,6,7,8-HxCDF | 0.00330 | Yes | V1 | 0.100 | 3.30E-04 | 0.100 | 3.30E-04 |
| BI31-013 | 03F2087-002 | 1,2,3,7,8,9-HxCDD | 0.00160 | Yes | V1 | 0.100 | 1.60E-04 | 0.100 | 1.60E-04 |
| BI31-013 | 03F2087-002 | 1,2,3,7,8,9-HxCDF | 2.90E-04 | Yes | V1 | 0.100 | 2.90E-05 | 0.100 | 2.90E-05 |
| BI31-013 | 03F2087-002 | 1,2,3,7,8-PeCDF | 0.00220 | Yes | V1 | 0.0500 | 1.10E-04 | 0.100 | 2.20E-04 |
| BI31-013 | 03F2087-002 | 2,3,4,6,7,8-HxCDF | 0.00400 | Yes | V1 | 0.100 | 4.00E-04 | 0.100 | 4.00E-04 |
| BI31-013 | 03F2087-002 | 2,3,4,7,8-PeCDF | 0.00370 | Yes | V1 | 0.500 | 0.00185 | 1 | 0.00370 |
| BI31-013 | 03F2087-002 | 2,3,7,8-TCDD | 6.10E-04 | Yes | V1 | 1 | 6.10E-04 | 1 | 6.10E-04 |
| BI31-013 | 03F2087-002 | 2,3,7,8-TCDF | 0.00220 | Yes | V1 | 0.100 | 2.20E-04 | 1 | 0.00220 |
| BI31-013 | 03F2087-002 | Heptachlorodibenzo-p-dioxin | 0.0150 | Yes | V1 | 0.0100 | 1.50E-04 | 0.00100 | 1.50E-05 |
| BI31-013 | 03F2087-002 | OCDD | 0.0850 | Yes | V1 | 1.00E-04 | 8.50E-06 | 1.00E-04 | 8.50E-06 |
| BI31-013 | 03F2087-002 | OCDF | 0.0120 | Yes | V1 | 1.00E-04 | 1.20E-06 | 1.00E-04 | 1.20E-06 |
| BI31-013 | 03F2087-002 | Pentachlorodibenzo-p-dioxin | 5.60E-04 | Yes | V1 | 1 | 5.60E-04 | 1 | 5.60E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-002:** | | | | | | | **0.00563** | | **0.00930** |
| BI31-015 | 04F0058-001 | 1,2,3,4,6,7,8-HpCDF | 0.00264 | No | V | 0.0100 | 0 | 0.0100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,4,7,8,9-HpCDF | 0.00264 | No | V | 0.0100 | 0 | 0.0100 | 0 |

**Table 1.9**
**Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors**

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | Mammals TEF [a] | Mammals TEQ Concentration [b] | Birds TEF [a] | Birds TEQ Concentration [b] |
|---|---|---|---|---|---|---|---|---|---|
| BI31-015 | 04F0058-001 | 1,2,3,4,7,8-HxCDD | 0.00264 | No | V | 0.100 | 0 | 0.0500 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,4,7,8-HxCDF | 0.00264 | No | V | 0.100 | 0 | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,6,7,8-HxCDD | 0.00264 | No | V | 0.100 | 0 | 0.0100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,6,7,8-HxCDF | 0.00264 | No | V | 0.100 | 0 | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,7,8,9-HxCDD | 0.00264 | No | V | 0.100 | 0 | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,7,8,9-HxCDF | 0.00264 | No | V | 0.100 | 0 | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 1,2,3,7,8-PeCDF | 0.00264 | No | V | 0.0500 | 0 | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 2,3,4,6,7,8-HxCDF | 0.00264 | No | V | 0.100 | 0 | 0.100 | 0 |
| BI31-015 | 04F0058-001 | 2,3,4,7,8-PeCDF | 0.00264 | No | V | 0.500 | 0 | 1 | 0 |
| BI31-015 | 04F0058-001 | 2,3,7,8-TCDD | 0.00106 | No | V | 1 | 0 | 1 | 0 |
| BI31-015 | 04F0058-001 | 2,3,7,8-TCDF | 0.00106 | No | V | 0.100 | 0 | 1 | 0 |
| BI31-015 | 04F0058-001 | Heptachlorodibenzo-p-dioxin | 0.00264 | No | V | 0.0100 | 0 | 0.00100 | 0 |
| BI31-015 | 04F0058-001 | OCDD | 4.15E-04 | Yes | JB | 1.00E-04 | 4.15E-08 | 1.00E-04 | 4.15E-08 |
| BI31-015 | 04F0058-001 | OCDF | 7.19E-05 | Yes | V | 1.00E-04 | 7.19E-09 | 1.00E-04 | 7.19E-09 |
| BI31-015 | 04F0058-001 | Pentachlorodibenzo-p-dioxin | 0.00264 | No | V | 1 | 0 | 1 | 0 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F0058-001:** | | | | | | | **4.87E-08** | | **4.87E-08** |
| BI31-016 | 04F0058-002 | 1,2,3,4,6,7,8-HpCDF | 2.35E-04 | Yes | V | 0.0100 | 2.35E-06 | 0.0100 | 2.35E-06 |
| BI31-016 | 04F0058-002 | 1,2,3,4,7,8,9-HpCDF | 0.00269 | No | V | 0.0100 | 0 | 0.0100 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,4,7,8-HxCDD | 0.00269 | No | V | 0.100 | 0 | 0.0500 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,4,7,8-HxCDF | 0.00269 | No | V | 0.100 | 0 | 0.100 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,6,7,8-HxCDD | 0.00269 | No | V | 0.100 | 0 | 0.0100 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,6,7,8-HxCDF | 0.00269 | No | V | 0.100 | 0 | 0.100 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,7,8,9-HxCDD | 2.20E-04 | Yes | V | 0.100 | 2.20E-05 | 0.100 | 2.20E-05 |
| BI31-016 | 04F0058-002 | 1,2,3,7,8,9-HxCDF | 0.00269 | No | V | 0.100 | 0 | 0.100 | 0 |
| BI31-016 | 04F0058-002 | 1,2,3,7,8-PeCDF | 0.00269 | No | V | 0.0500 | 0 | 0.100 | 0 |
| BI31-016 | 04F0058-002 | 2,3,4,6,7,8-HxCDF | 0.00269 | No | V | 0.100 | 0 | 0.100 | 0 |
| BI31-016 | 04F0058-002 | 2,3,4,7,8-PeCDF | 0.00269 | No | V | 0.500 | 0 | 1 | 0 |
| BI31-016 | 04F0058-002 | 2,3,7,8-TCDD | 2.59E-05 | Yes | V | 1 | 2.59E-05 | 1 | 2.59E-05 |
| BI31-016 | 04F0058-002 | 2,3,7,8-TCDF | 0.00108 | No | V | 0.100 | 0 | 1 | 0 |
| BI31-016 | 04F0058-002 | Heptachlorodibenzo-p-dioxin | 2.48E-04 | Yes | V | 0.0100 | 2.48E-06 | 0.00100 | 2.48E-07 |
| BI31-016 | 04F0058-002 | OCDD | 0.00208 | Yes | JB | 1.00E-04 | 2.08E-07 | 1.00E-04 | 2.08E-07 |
| BI31-016 | 04F0058-002 | OCDF | 3.58E-04 | Yes | V | 1.00E-04 | 3.58E-08 | 1.00E-04 | 3.58E-08 |
| BI31-016 | 04F0058-002 | Pentachlorodibenzo-p-dioxin | 0.00269 | No | V | 1 | 0 | 1 | 0 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample04F0058-002:** | | | | | | | **5.30E-05** | | **5.07E-05** |
| BJ31-005 | 03F2087-004 | 1,2,3,4,6,7,8-HpCDF | 0.00990 | Yes | V1 | 0.0100 | 9.90E-05 | 0.0100 | 9.90E-05 |
| BJ31-005 | 03F2087-004 | 1,2,3,4,7,8,9-HpCDF | 7.10E-04 | Yes | V1 | 0.0100 | 7.10E-06 | 0.0100 | 7.10E-06 |
| BJ31-005 | 03F2087-004 | 1,2,3,4,7,8-HxCDD | 7.20E-04 | Yes | V1 | 0.100 | 7.20E-05 | 0.0500 | 3.60E-05 |

**Table 1.9**

**Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors**

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | Mammals TEF[a] | Mammals TEQ Concentration[b] | Birds TEF[a] | Birds TEQ Concentration[b] |
|---|---|---|---|---|---|---|---|---|---|
| BJ31-005 | 03F2087-004 | 1,2,3,4,7,8-HxCDF | 0.00480 | Yes | V1 | 0.100 | 4.80E-04 | 0.100 | 4.80E-04 |
| BJ31-005 | 03F2087-004 | 1,2,3,6,7,8-HxCDD | 0.00140 | Yes | V1 | 0.100 | 1.40E-04 | 0.0100 | 1.40E-05 |
| BJ31-005 | 03F2087-004 | 1,2,3,6,7,8-HxCDF | 0.00180 | Yes | V1 | 0.100 | 1.80E-04 | 0.100 | 1.80E-04 |
| BJ31-005 | 03F2087-004 | 1,2,3,7,8,9-HxCDD | 0.00120 | Yes | V1 | 0.100 | 1.20E-04 | 0.100 | 1.20E-04 |
| BJ31-005 | 03F2087-004 | 1,2,3,7,8,9-HxCDF | 2.60E-04 | No | V1 | 0.100 | 0 | 0.100 | 0 |
| BJ31-005 | 03F2087-004 | 1,2,3,7,8-PeCDF | 0.00110 | Yes | V1 | 0.0500 | 5.50E-05 | 0.100 | 1.10E-04 |
| BJ31-005 | 03F2087-004 | 2,3,4,6,7,8-HxCDF | 0.00220 | Yes | V1 | 0.100 | 2.20E-04 | 0.100 | 2.20E-04 |
| BJ31-005 | 03F2087-004 | 2,3,4,7,8-PeCDF | 0.00170 | Yes | V1 | 0.500 | 8.50E-04 | 1 | 0.00170 |
| BJ31-005 | 03F2087-004 | 2,3,7,8-TCDD | 2.80E-04 | Yes | V1 | 1 | 2.80E-04 | 1 | 2.80E-04 |
| BJ31-005 | 03F2087-004 | 2,3,7,8-TCDF | 0.00120 | Yes | V1 | 0.100 | 1.20E-04 | 1 | 0.00120 |
| BJ31-005 | 03F2087-004 | Heptachlorodibenzo-p-dioxin | 0.0200 | Yes | V1 | 0.0100 | 2.00E-04 | 0.00100 | 2.00E-05 |
| BJ31-005 | 03F2087-004 | OCDD | 0.170 | Yes | J1 | 1.00E-04 | 1.70E-05 | 1.00E-04 | 1.70E-05 |
| BJ31-005 | 03F2087-004 | OCDF | 0.0110 | Yes | V1 | 1.00E-04 | 1.10E-06 | 1.00E-04 | 1.10E-06 |
| BJ31-005 | 03F2087-004 | Pentachlorodibenzo-p-dioxin | 4.50E-04 | Yes | V1 | 1 | 4.50E-04 | 1 | 4.50E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-004:** | | | | | | | **0.00329** | | **0.00493** |
| BJ31-006 | 03F2087-005 | 1,2,3,4,6,7,8-HpCDF | 0.0130 | Yes | V1 | 0.0100 | 1.30E-04 | 0.0100 | 1.30E-04 |
| BJ31-006 | 03F2087-005 | 1,2,3,4,7,8,9-HpCDF | 0.00130 | Yes | V1 | 0.0100 | 1.30E-05 | 0.0100 | 1.30E-05 |
| BJ31-006 | 03F2087-005 | 1,2,3,4,7,8-HxCDD | 5.50E-04 | Yes | V1 | 0.100 | 5.50E-05 | 0.0500 | 2.75E-05 |
| BJ31-006 | 03F2087-005 | 1,2,3,4,7,8-HxCDF | 0.00540 | Yes | V1 | 0.100 | 5.40E-04 | 0.100 | 5.40E-04 |
| BJ31-006 | 03F2087-005 | 1,2,3,6,7,8-HxCDD | 0.00160 | Yes | V1 | 0.100 | 1.60E-04 | 0.0100 | 1.60E-05 |
| BJ31-006 | 03F2087-005 | 1,2,3,6,7,8-HxCDF | 0.00210 | Yes | V1 | 0.100 | 2.10E-04 | 0.100 | 2.10E-04 |
| BJ31-006 | 03F2087-005 | 1,2,3,7,8,9-HxCDD | 0.00120 | Yes | V1 | 0.100 | 1.20E-04 | 0.100 | 1.20E-04 |
| BJ31-006 | 03F2087-005 | 1,2,3,7,8,9-HxCDF | 3.60E-04 | No | V1 | 0.100 | 0 | 0.100 | 0 |
| BJ31-006 | 03F2087-005 | 1,2,3,7,8-PeCDF | 0.00130 | Yes | V1 | 0.0500 | 6.50E-05 | 0.100 | 1.30E-04 |
| BJ31-006 | 03F2087-005 | 2,3,4,6,7,8-HxCDF | 0.00250 | Yes | V1 | 0.100 | 2.50E-04 | 0.100 | 2.50E-04 |
| BJ31-006 | 03F2087-005 | 2,3,4,7,8-PeCDF | 0.00200 | Yes | V1 | 0.500 | 0.00100 | 1 | 0.00200 |
| BJ31-006 | 03F2087-005 | 2,3,7,8-TCDD | 2.20E-04 | No | V1 | 1 | 0 | 1 | 0 |
| BJ31-006 | 03F2087-005 | 2,3,7,8-TCDF | 0.00130 | Yes | V1 | 0.100 | 1.30E-04 | 1 | 0.00130 |
| BJ31-006 | 03F2087-005 | Heptachlorodibenzo-p-dioxin | 0.0200 | Yes | V1 | 0.0100 | 2.00E-04 | 0.00100 | 2.00E-05 |
| BJ31-006 | 03F2087-005 | OCDD | 0.150 | Yes | J1 | 1.00E-04 | 1.50E-05 | 1.00E-04 | 1.50E-05 |
| BJ31-006 | 03F2087-005 | OCDF | 0.0120 | Yes | V1 | 1.00E-04 | 1.20E-06 | 1.00E-04 | 1.20E-06 |
| BJ31-006 | 03F2087-005 | Pentachlorodibenzo-p-dioxin | 6.20E-04 | Yes | V1 | 1 | 6.20E-04 | 1 | 6.20E-04 |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-005:** | | | | | | | **0.004** | | **0.00539** |
| **2,3,7,8-TCDD TEQ Concentration used in Surface Soil ESL Screen[c]:** | | | | | | | **0.074** | | **0.126** |
| **Subsurface Soil (ug/kg)** | | | | | | | | | |
| BI31-009 | 03F0329-005 | 1,2,3,4,6,7,8-HpCDF | 0.00480 | Yes | V | 0.0100 | 4.80E-05 | N/A | N/A |
| BI31-009 | 03F0329-005 | 1,2,3,4,7,8,9-HpCDF | 6.00E-04 | Yes | JB | 0.0100 | 6.00E-06 | N/A | N/A |

Table 1.9

Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors

| Sampling Location | Sample Number | Congener | Result | Detect? | Validation Qualifier | Mammals | | Birds | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | TEF [a] | TEQ Concentration [b] | TEF [a] | TEQ Concentration [b] |
| BI31-009 | 03F0329-005 | 1,2,3,4,7,8-HxCDD | 3.40E-04 | Yes | JB | 0.100 | 3.40E-05 | N/A | N/A |
| BI31-009 | 03F0329-005 | 1,2,3,4,7,8-HxCDF | 0.00290 | Yes | V | 0.100 | 2.90E-04 | N/A | N/A |
| BI31-009 | 03F0329-005 | 1,2,3,6,7,8-HxCDD | 6.10E-04 | Yes | JB | 0.100 | 6.10E-05 | N/A | N/A |
| BI31-009 | 03F0329-005 | 1,2,3,6,7,8-HxCDF | 0.00120 | Yes | JB | 0.100 | 1.20E-04 | N/A | N/A |
| BI31-009 | 03F0329-005 | 1,2,3,7,8,9-HxCDD | 8.40E-04 | Yes | JB | 0.100 | 8.40E-05 | N/A | N/A |
| BI31-009 | 03F0329-005 | 1,2,3,7,8,9-HxCDF | 1.40E-04 | Yes | JB | 0.100 | 1.40E-05 | N/A | N/A |
| BI31-009 | 03F0329-005 | 1,2,3,7,8-PeCDF | 9.30E-04 | Yes | JB | 0.0500 | 4.65E-05 | N/A | N/A |
| BI31-009 | 03F0329-005 | 2,3,4,6,7,8-HxCDF | 0.00120 | Yes | JB | 0.100 | 1.20E-04 | N/A | N/A |
| BI31-009 | 03F0329-005 | 2,3,4,7,8-PeCDF | 0.00160 | Yes | JB | 0.500 | 8.00E-04 | N/A | N/A |
| BI31-009 | 03F0329-005 | 2,3,7,8-TCDD | 2.40E-04 | Yes | V | 1 | 2.40E-04 | N/A | N/A |
| BI31-009 | 03F0329-005 | 2,3,7,8-TCDF | 0.00110 | Yes | V | 0.100 | 1.10E-04 | N/A | N/A |
| BI31-009 | 03F0329-005 | Heptachlorodibenzo-p-dioxin | 0.00960 | Yes | V | 0.0100 | 9.60E-05 | N/A | N/A |
| BI31-009 | 03F0329-005 | OCDD | 0.0750 | Yes | V | 1.00E-04 | 7.50E-06 | N/A | N/A |
| BI31-009 | 03F0329-005 | OCDF | 0.00620 | Yes | V | 1.00E-04 | 6.20E-07 | N/A | N/A |
| BI31-009 | 03F0329-005 | Pentachlorodibenzo-p-dioxin | 3.50E-04 | Yes | JB | 1 | 3.50E-04 | N/A | N/A |
| **Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-005:** | | | | | | | **0.00243** | | N/A |
| **2,3,7,8-TCDD TEQ Concentration used in Subsurface Soil ESL Screen[c]:** | | | | | | | **0.00243** | | N/A |

[a] Toxicity Equivalency Factor (WHO, 1997).

[b] TEQ (Toxicity Equivalence) concentration = Soil Concentration x TEF. For non-detects, the TEQ concentration equals zero.

[c] The 2,3,7,8-TCDD TEQ concentration used in the ESL screen is the maximum of all sampling locations for the medium.

N/A = Not applicable.

**Table 2.1**
**Essential Nutrient Screen for Surface Soil/Surface Sediment**

| Analyte | MDC (mg/kg) | Estimated Maximum Daily Intake[a] (mg/day) | RDA/RDI/AI[b] (mg/day) | UL[b] (mg/day) | Retain for PRG Screen? |
|---|---|---|---|---|---|
| Calcium | 69,700 | 6.97 | 500-1,200 | 2,500 | No |
| Magnesium | 6,600 | 0.660 | 80-420 | 65-110 | No |
| Potassium | 4,460 | 0.446 | 2,000-3,500 | N/A | No |
| Sodium | 2,060 | 0.206 | 500-2,400 | N/A | No |

[a] Based on the MDC and a 100-mg/day soil ingestion rate for a WRW.

[b] RDA/RDI/AI/UL taken from NAS 2000 and 2002.

N/A = Not available.

**Table 2.2**
**PRG Screen for Surface Soil/Surface Sediment**

| Analyte | PRG[a] | MDC | MDC Exceeds PRG? | UCL[b] | UCL Exceeds PRG? | Retain for Detection Frequency Screen? |
|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)** | | | | | | |
| Aluminum | 24,774 | 30,200 | Yes | 11,533 | No | No |
| Ammonia | 910,997 | 4.40 | No | -- | -- | No |
| Antimony | 44.4 | 51.3 | Yes | 9.91 | No | No |
| **Arsenic** | **2.41** | **27.9** | **Yes** | **6.11** | **Yes** | **Yes** |
| Barium | 2,872 | 464 | No | -- | -- | No |
| Beryllium | 100 | 4.40 | No | -- | -- | No |
| Boron | 9,477 | 11 | No | -- | -- | No |
| Cadmium | 91.4 | 30 | No | -- | -- | No |
| Cesium | N/A | 16.4 | UT | -- | -- | No |
| Chromium[c] | 28.4 | 70.1 | Yes | 15.8 | No | No |
| Chromium VI | 28.4 | 0.0120 | No | -- | -- | No |
| Cobalt | 122 | 13.7 | No | -- | -- | No |
| Copper | 4,443 | 330 | No | -- | -- | No |
| Fluoride | 6,665 | 20.3 | No | -- | -- | No |
| Iron | 33,326 | 38,800 | Yes | 14,758 | No | No |
| Lead | 1,000 | 220 | No | -- | -- | No |
| Lithium | 2,222 | 20 | No | -- | -- | No |
| Manganese | 419 | 829 | Yes | 273 | No | No |
| Mercury | 32.9 | 3.80 | No | -- | -- | No |
| Molybdenum | 555 | 11.7 | No | -- | -- | No |
| Nickel | 2,222 | 48 | No | -- | -- | No |
| Nitrate / Nitrite[d] | 177,739 | 32 | No | -- | -- | No |
| Selenium | 555 | 3.80 | No | -- | -- | No |
| Silica | N/A | 1,200 | UT | -- | -- | No |
| Silicon | N/A | 1,890 | UT | -- | -- | No |
| Silver | 555 | 98 | No | -- | -- | No |
| Strontium | 66,652 | 150 | No | -- | -- | No |
| Thallium | 7.78 | 0.990 | No | -- | -- | No |
| Tin | 66,652 | 66.9 | No | -- | -- | No |
| Titanium | 169,568 | 410 | No | -- | -- | No |
| Uranium | 333 | 85 | No | -- | -- | No |
| Vanadium | 111 | 68.6 | No | -- | -- | No |
| Zinc | 33,326 | 2,080 | No | -- | -- | No |
| **Organics (ug/kg)** | | | | | | |
| 1,2,4-Trichlorobenzene | 151,360 | 0.950 | No | -- | -- | No |
| 1,2,4-Trimethylbenzene | 132,620 | 1.50 | No | -- | -- | No |
| **2,3,7,8-TCDD TEQ[e]** | **0.0248** | **0.0739** | **Yes** | **0.0546** | **Yes** | **Yes** |
| 2-Butanone | 4.64E+07 | 380 | No | -- | -- | No |
| 2-Methylnaphthalene | 320,574 | 12,000 | No | -- | -- | No |
| 4,4'-DDT | 10,927 | 21 | No | -- | -- | No |
| 4-Methyl-2-pentanone | 8.32E+07 | 4 | No | -- | -- | No |
| 4-Methylphenol | 400,718 | 510 | No | -- | -- | No |
| Acenaphthene | 4.44E+06 | 44,000 | No | -- | -- | No |
| Acenaphthylene | N/A | 600 | UT | -- | -- | No |
| Acetone | 1.00E+08 | 890 | No | -- | -- | No |
| Aldrin | 176 | 17 | No | -- | -- | No |
| Anthracene | 2.22E+07 | 47,000 | No | -- | -- | No |
| Aroclor-1254 | 1,349 | 3,900 | Yes | 597 | No | No |

**Table 2.2**
**PRG Screen for Surface Soil/Surface Sediment**

| Analyte | PRG[a] | MDC | MDC Exceeds PRG? | UCL[b] | UCL Exceeds PRG? | Retain for Detection Frequency Screen? |
|---|---|---|---|---|---|---|
| Aroclor-1260 | 1,349 | 600 | No | -- | -- | No |
| Benzene | 23,563 | 1.20 | No | -- | -- | No |
| Benzo(a)anthracene | 3,793 | 45,000 | Yes | 2,521 | No | No |
| **Benzo(a)pyrene** | **379** | **43,000** | **Yes** | **2,249** | **Yes** | **Yes** |
| Benzo(b)fluoranthene | 3,793 | 49,000 | Yes | 3,448 | No | No |
| Benzo(g,h,i)perylene | N/A | 28,000 | UT | -- | -- | No |
| Benzo(k)fluoranthene | 37,927 | 25,000 | No | -- | -- | No |
| Benzoic Acid | 3.21E+08 | 770 | No | -- | -- | No |
| Benzyl Alcohol | 2.40E+07 | 270 | No | -- | -- | No |
| bis(2-ethylhexyl)phthalate | 213,750 | 3,500 | No | -- | -- | No |
| Butylbenzylphthalate | 1.60E+07 | 220 | No | -- | -- | No |
| Carbazole | 150,001 | 39 | No | -- | -- | No |
| Chrysene | 379,269 | 46,000 | No | -- | -- | No |
| **Dibenz(a,h)anthracene** | **379** | **9,200** | **Yes** | **709** | **Yes** | **Yes** |
| Dibenzofuran | 222,174 | 20,000 | No | -- | -- | No |
| Dieldrin | 187 | 34 | No | -- | -- | No |
| Diethylphthalate | 6.41E+07 | 79 | No | -- | -- | No |
| Di-n-butylphthalate | 8.01E+06 | 390 | No | -- | -- | No |
| Di-n-octylphthalate | 3.21E+06 | 96 | No | -- | -- | No |
| Endosulfan sulfate | 480,861 | 24 | No | -- | -- | No |
| Endrin ketone | 33,326 | 36 | No | -- | -- | No |
| Fluoranthene | 2.96E+06 | 140,000 | No | -- | -- | No |
| Fluorene | 3.21E+06 | 39,000 | No | -- | -- | No |
| Heptachlor epoxide | 329 | 10 | No | -- | -- | No |
| Indeno(1,2,3-cd)pyrene | 3,793 | 32,000 | Yes | 2,445 | No | No |
| Isophorone | 3.16E+06 | 96 | No | -- | -- | No |
| Methoxychlor | 400,718 | 450 | No | -- | -- | No |
| Methylene Chloride | 271,792 | 220 | No | -- | -- | No |
| Naphthalene | 1.40E+06 | 41,000 | No | -- | -- | No |
| Phenanthrene | N/A | 170,000 | UT | -- | -- | No |
| Phenol | 2.40E+07 | 80 | No | -- | -- | No |
| Pyrene | 2.22E+06 | 120,000 | No | -- | -- | No |
| Tetrachloroethene | 6,705 | 6 | No | -- | -- | No |
| Toluene | 3.09E+06 | 310 | No | -- | -- | No |
| Trichloroethene | 1,770 | 23 | No | -- | -- | No |
| Xylene[f] | 1.06E+06 | 5 | No | -- | -- | No |
| **Radionuclides (pCi/g)** | | | | | | |
| Americium-241 | 7.69 | 0.802 | No | -- | -- | No |
| **Cesium-134** | **0.0800** | **0.300** | **Yes** | **0.138** | **Yes** | **Yes** |
| **Cesium-137** | **0.221** | **1** | **Yes** | **0.238** | **Yes** | **Yes** |
| Gross Alpha | N/A | 320 | UT | -- | -- | No |
| Gross Beta | N/A | 305 | UT | -- | -- | No |
| Neptunium-237 | 5.43 | 0.00224 | No | -- | -- | No |
| Plutonium-238 | 5.97 | 0.0253 | No | -- | -- | No |
| Plutonium-239/240 | 9.80 | 17.1 | Yes | 0.147 | No | No |
| Radium-226 | 2.69 | 1.09 | No | -- | -- | No |
| **Radium-228** | **0.111** | **2.29** | **Yes** | **1.73** | **Yes** | **Yes** |
| Strontium-89/90 | 13.2 | 4.86 | No | -- | -- | No |
| Uranium-233/234 | 25.3 | 47.5 | Yes | 2.56 | No | No |

**Table 2.2**
**PRG Screen for Surface Soil/Surface Sediment**

| Analyte | PRG[a] | MDC | MDC Exceeds PRG? | UCL[b] | UCL Exceeds PRG? | Retain for Detection Frequency Screen? |
|---|---|---|---|---|---|---|
| Uranium-235 | 1.05 | 2.24 | Yes | 0.159 | No | No |
| Uranium-238 | 29.3 | 209 | Yes | 8.34 | No | No |

[a] The value shown is equal to the most stringent of the PRGs based on a risk of 1E-06 or an HQ of 0.1.

[b] UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the UCL.

[c] The PRG for chromium (VI) is used.

[d] The PRG for nitrate is used.

[e] The TEQ for 2,3,7,8-TCDD is calculated in Table 1.8 and the PRG for 2,3,7,8-TCDD is used in the PRG screen.

[f] The value for total xylene is used.

N/A = Not available.

UT = Uncertain toxicity; no PRG available (assessed in Section 6.0).

-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.

**Bold = Analyte retained for further consideration in the next COC selection step.**

**Table 2.3**
**Statistical Distributions and Comparison to Background for UWOEU[a]**

| Analyte | Statistical Distribution Testing Results | | | | | | Background Comparison | | |
|---|---|---|---|---|---|---|---|---|---|
| | Background | | | UWOEU | | | | | |
| | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Test | 1-p | Retain as PCOC? |
| **Surface Soil/Surface Sediment** | | | | | | | | | |
| **Arsenic** | **20** | **NORMAL** | **91.8** | **130** | **NORMAL** | **99.4** | **t-Test_N** | **1.38E-05** | **Yes** |
| Cesium-134 | 70 | NONPARAMETRIC | N/A | N/A | N/A | N/A | WRS | 0.900 | No |
| Cesium-137 | 70 | NORMAL | N/A | 1 | N/A | N/A | WRS | 1.000 | No |
| Radium-228 | 20 | NORMAL | N/A | 4 | NORMAL | N/A | t-Test_N | 0.651 | No |
| Uranium-235 | 20 | GAMMA | N/A | 154 | NONPARAMETRIC | N/A | WRS | 0.554 | No |
| **Subsurface Soil/Subsurface Sediment** | | | | | | | | | |
| Radium-228 | 31 | GAMMA | N/A | 26 | NORMAL | N/A | WRS | 0.170 | No |

[a] EU data for background comparison do not include data from background locations.
t-Test_N = Student's t-test using normal data

**Table 2.4**
**Essential Nutrient Screen for Subsurface Soil/Subsurface Sediment**

| Analyte | MDC (mg/kg) | Estimated Maximum Daily Intake[a] (mg/day) | RDA/RDI/AI[b] (mg/day) | UL[b] (mg/day) | Retain for PRG Screen? |
|---|---|---|---|---|---|
| Calcium | 60,000 | 6 | 500-1,200 | 2,500 | No |
| Magnesium | 9,480 | 0.948 | 80-420 | 65-110 | No |
| Potassium | 4,190 | 0.419 | 2,000-3,500 | N/A | No |
| Sodium | 3,360 | 0.336 | 500-2,400 | N/A | No |

[a] Based on the MDC and a 100-mg/day soil ingestion rate for a WRW.

[b] RDA/RDI/AI/UL taken from NAS 2000 and 2002.

N/A = Not available.

**Table 2.5**
**PRG Screen for Subsurface Soil/Subsurface Sediment**

| Analyte | PRG[a] | MDC | MDC Exceeds PRG? | UCL[b] | UCL Exceeds PRG? | Retain for Detection Frequency Screen? |
|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)** | | | | | | |
| Aluminum | 284,902 | 32,800 | No | -- | -- | No |
| Antimony | 511 | 149 | No | -- | -- | No |
| Arsenic | 27.7 | 24.3 | No | -- | -- | No |
| Barium | 33,033 | 1,610 | No | -- | -- | No |
| Beryllium | 1,151 | 446 | No | -- | -- | No |
| Boron | 108,980 | 4.70 | No | -- | -- | No |
| Cadmium | 1,051 | 71 | No | -- | -- | No |
| Cesium | N/A | 29.6 | UT | -- | -- | No |
| Chromium[c] | 327 | 8,310 | Yes | 196 | No | No |
| Cobalt | 1,401 | 701 | No | -- | -- | No |
| Copper | 51,100 | 8,850 | No | -- | -- | No |
| Iron | 383,250 | 107,000 | No | -- | -- | No |
| Lead | 1,000 | 5,200 | Yes | 73.4 | No | No |
| Lithium | 25,550 | 29 | No | -- | -- | No |
| Manganese | 4,815 | 2,150 | No | -- | -- | No |
| Mercury | 379 | 1.40 | No | -- | -- | No |
| Molybdenum | 6,388 | 470 | No | -- | -- | No |
| Nickel | 25,550 | 4,750 | No | -- | -- | No |
| Phosphorus | N/A | 975 | UT | -- | -- | No |
| Selenium | 6,388 | 80.8 | No | -- | -- | No |
| Silica | N/A | 850 | UT | -- | -- | No |
| Silicon | N/A | 1,120 | UT | -- | -- | No |
| Silver | 6,388 | 311 | No | -- | -- | No |
| Strontium | 766,500 | 170 | No | -- | -- | No |
| Thallium | 89.4 | 6.30 | No | -- | -- | No |
| Tin | 766,500 | 579 | No | -- | -- | No |
| Titanium | 1.95E+06 | 283 | No | -- | -- | No |
| Total Petroleum Hydrocarbons | N/A | 62 | UT | -- | -- | No |
| Uranium | 3,833 | 5.50 | No | -- | -- | No |
| Vanadium | 1,278 | 74.4 | No | -- | -- | No |
| Zinc | 383,250 | 6,920 | No | -- | -- | No |
| **Organics (ug/kg)** | | | | | | |
| 1,1,1-Trichloroethane | 1.06E+08 | 2 | No | -- | -- | No |
| 1,2,4-Trichlorobenzene | 1.74E+06 | 60 | No | -- | -- | No |
| 1,2-Dichlorobenzene | 3.32E+07 | 30 | No | -- | -- | No |
| 1,3-Dichlorobenzene | 3.83E+07 | 20 | No | -- | -- | No |
| 1,4-Dichlorobenzene | 1.05E+06 | 10 | No | -- | -- | No |
| 2,3,7,8-TCDD TEQ[d] | 0.285 | 0.00243 | No | -- | -- | No |
| 2-Butanone | 5.33E+08 | 8 | No | -- | -- | No |
| 2-Chlorophenol | 6.39E+06 | 10 | No | -- | -- | No |
| 2-Methylnaphthalene | 3.69E+06 | 15,000 | No | -- | -- | No |
| 3,3'-Dichlorobenzidine | 76,667 | 160 | No | -- | -- | No |
| 4-Chloro-3-methylphenol | N/A | 10 | UT | -- | -- | No |
| 4-Methyl-2-pentanone | 9.57E+08 | 2 | No | -- | -- | No |

**Table 2.5**
**PRG Screen for Subsurface Soil/Subsurface Sediment**

| Analyte | PRG[a] | MDC | MDC Exceeds PRG? | UCL[b] | UCL Exceeds PRG? | Retain for Detection Frequency Screen? |
|---|---|---|---|---|---|---|
| Acenaphthene | 5.10E+07 | 31,000 | No | -- | -- | No |
| Acenaphthylene | N/A | 47 | UT | -- | -- | No |
| Acetone | 1.15E+09 | 330 | No | -- | -- | No |
| alpha-BHC | 6,555 | 15 | No | -- | -- | No |
| Anthracene | 2.55E+08 | 46,000 | No | -- | -- | No |
| Aroclor-1254 | 15,514 | 960 | No | -- | -- | No |
| Aroclor-1260 | 15,514 | 1,300 | No | -- | -- | No |
| Benzo(a)anthracene | 43,616 | 48,000 | Yes | 2,743 | No | No |
| Benzo(a)pyrene | 4,357 | 43,000 | Yes | 2,482 | No | No |
| Benzo(b)fluoranthene | 43,616 | 48,000 | Yes | 2,785 | No | No |
| Benzo(g,h,i)perylene | N/A | 19,000 | UT | -- | -- | No |
| Benzo(k)fluoranthene | 436,159 | 19,000 | No | -- | -- | No |
| Benzoic Acid | 3.69E+09 | 260 | No | -- | -- | No |
| bis(2-ethylhexyl)phthalate | 2.46E+06 | 540 | No | -- | -- | No |
| Bromoform | 4.83E+06 | 2 | No | -- | -- | No |
| Butylbenzylphthalate | 1.84E+08 | 1,400 | No | -- | -- | No |
| Chrysene | 4.36E+06 | 53,000 | No | -- | -- | No |
| cis-1,2-Dichloroethene | 1.28E+07 | 10.1 | No | -- | -- | No |
| Dibenz(a,h)anthracene | 4,362 | 890 | No | -- | -- | No |
| Dibenzofuran | 2.56E+06 | 20,000 | No | -- | -- | No |
| Diethylphthalate | 7.37E+08 | 250 | No | -- | -- | No |
| Di-n-butylphthalate | 9.22E+07 | 2,700 | No | -- | -- | No |
| Di-n-octylphthalate | 3.69E+07 | 50 | No | -- | -- | No |
| Fluoranthene | 3.40E+07 | 160,000 | No | -- | -- | No |
| Fluorene | 3.69E+07 | 35,000 | No | -- | -- | No |
| Heptachlor | 7,647 | 3.10 | No | -- | -- | No |
| Heptachlor epoxide | 3,782 | 11 | No | -- | -- | No |
| Hexachlorobenzene | 21,508 | 30 | No | -- | -- | No |
| Indeno(1,2,3-cd)pyrene | 43,616 | 22,000 | No | -- | -- | No |
| Isophorone | 3.63E+07 | 82 | No | -- | -- | No |
| Methylene Chloride | 3.13E+06 | 67 | No | -- | -- | No |
| Naphthalene | 1.61E+07 | 61,000 | No | -- | -- | No |
| Pentachlorophenol | 202,777 | 160 | No | -- | -- | No |
| Phenanthrene | N/A | 220,000 | UT | -- | -- | No |
| Phenol | 2.76E+08 | 140 | No | -- | -- | No |
| Pyrene | 2.55E+07 | 150,000 | No | -- | -- | No |
| Tetrachloroethene | 77,111 | 920 | No | -- | -- | No |
| Toluene | 3.56E+07 | 420 | No | -- | -- | No |
| Trichloroethene | 20,354 | 440 | No | -- | -- | No |
| **Radionuclides (pCi/g)** | | | | | | |
| Americium-241 | 88.4 | 2.97 | No | -- | -- | No |
| Cesium-134 | 0.910 | -0.0657 | No | -- | -- | No |
| Cesium-137 | 2.54 | 0.176 | No | -- | -- | No |
| Gross Alpha | N/A | 742 | UT | -- | -- | No |
| Gross Beta | N/A | 1,580 | UT | -- | -- | No |
| Plutonium-238 | 68.7 | 9.84 | No | -- | -- | No |

**Table 2.5**
**PRG Screen for Subsurface Soil/Subsurface Sediment**

| Analyte | PRG[a] | MDC | MDC Exceeds PRG? | UCL[b] | UCL Exceeds PRG? | Retain for Detection Frequency Screen? |
|---|---|---|---|---|---|---|
| Plutonium-239/240 | 112 | 5.16 | No | -- | -- | No |
| Radium-226 | 31 | 2.09 | No | -- | -- | No |
| **Radium-228** | **1.28** | **2.79** | **Yes** | **1.74** | **Yes** | **Yes** |
| Strontium-89/90 | 152 | 0.969 | No | -- | -- | No |
| Uranium-233/234 | 291 | 288 | No | -- | -- | No |
| Uranium-235 | 12.1 | 37.7 | Yes | 1.80 | No | No |
| Uranium-238 | 337 | 1,160 | Yes | 78.7 | No | No |

[a] The value shown is equal to the most stringent of the PRGs based on a risk of 1E-06 or an HQ of 0.1.

[b] UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the UCL.

[c] The PRG for chromium (VI) is used.

[d] The TEQ for 2,3,7,8-TCDD is calculated in Table 1.8 and the PRG for 2,3,7,8-TCDD is used in the PRG screen.

N/A = Not available.

UT = Uncertain toxicity; no PRG available (assessed in Section 6.0).

-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.

**Bold = Analyte retained for further consideration in the next COC selection step.**

## Table 2.6
## Summary of the COC Selection Process

| Analyte | MDC Exceeds PRG? | UCL Exceeds PRG? | Detection Frequency > 5%[a] | Exceeds 30X the PRG? | Exceeds Background? | Professional Judgment-Retain? | Retain as COC? |
|---|---|---|---|---|---|---|---|
| **Surface Soil/Surface Sediment** | | | | | | | |
| **2,3,7,8-TCDD TEQ** | **Yes** | **Yes** | **Yes** | **N/A** | **N/A** | **Yes** | **Yes** |
| Aluminum | Yes | No | -- | -- | -- | -- | No |
| Antimony | Yes | No | -- | -- | -- | -- | No |
| Aroclor-1254 | Yes | No | -- | -- | -- | -- | No |
| Arsenic | Yes | Yes | Yes | N/A | Yes | No | No |
| Benzo(a)anthracene | Yes | No | -- | -- | -- | -- | No |
| **Benzo(a)pyrene** | **Yes** | **Yes** | **Yes** | **N/A** | **N/A** | **Yes** | **Yes** |
| Benzo(b)fluoranthene | Yes | No | -- | -- | -- | -- | No |
| Cesium-134 | Yes | Yes | N/A | N/A | No | -- | No |
| Cesium-137 | Yes | Yes | N/A | N/A | No | -- | No |
| Chromium | Yes | No | -- | -- | -- | -- | No |
| Dibenz(a,h)anthracene | Yes | Yes | No | No | -- | -- | No |
| Indeno(1,2,3-cd)pyrene | Yes | No | -- | -- | -- | -- | No |
| Iron | Yes | No | -- | -- | -- | -- | No |
| Manganese | Yes | No | -- | -- | -- | -- | No |
| Plutonium 239/240 | Yes | No | -- | -- | -- | -- | No |
| Radium-228 | Yes | Yes | N/A | N/A | No | -- | No |
| Uranium-233/234 | Yes | No | -- | -- | -- | -- | No |
| Uranium-235 | Yes | No | -- | -- | -- | -- | No |
| Uranium-238 | Yes | No | -- | -- | -- | -- | No |
| **Subsurface Soil/ Subsurface Sediment** | | | | | | | |
| Chromium | Yes | No | -- | -- | -- | -- | No |
| Lead | Yes | No | -- | -- | -- | -- | No |
| Benzo(a)pyrene | Yes | No | -- | -- | -- | -- | No |
| Benzo(a)anthracene | Yes | No | -- | -- | -- | -- | No |
| Benzo(b)fluoranthene | Yes | No | -- | -- | -- | -- | No |
| Radium-228 | Yes | Yes | N/A | N/A | No | -- | No |
| Uranium-235 | Yes | No | -- | -- | -- | -- | No |
| Uranium-238 | Yes | No | -- | -- | -- | -- | No |

[a] All radionuclide values are considered detects.
N/A = Not applicable.
-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.
**Bold = Analyte retained as a COC for risk characterization.**

## Table 3.1
### Exposure Point Concentrations

| Analyte[f] | Unit | MDC[a] | UCL Value[b] | UCL Type[c] | Distribution[d] | EPC[e] |
|---|---|---|---|---|---|---|
| **Tier 1** | | | | | | |
| **Surface Soil/Surface Sediment** | | | | | | |
| Benzo(a)pyrene | mg/kg | 43 | 2.25 | 95% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 2.25 |
| 2,3,7,8-TCDD TEQ | mg/kg | 7.39E-05 | 5.46E-05 | 95% Adjusted Gamma UCL | GAMMA | 5.46E-05 |
| **Tier 2** | | | | | | |
| **Surface Soil/Surface Sediment** | | | | | | |
| Benzo(a)pyrene | mg/kg | 1.35 | 0.343 | 95% Student's-t UCL | NORMAL | 0.343 |
| 2,3,7,8-TCDD TEQ | mg/kg | 1.05E-05 | N/A | N/A | N/A | 5.46E-05 |

[a] The MDC for Tier 1 is the maximum detected concentration of all samples and the MDC for Tier 2 is the maximum of the average concentration of the samples in each of the 30-acre grids in the EU.

[b] UCL = 95% upper confidence limit

[c] The Tier 1 UCL type is recommended by ProUCL.

[d] The Tier 1 distribution is recommended by ProUCL.

[e] The UCL is used as the EPC, unless the UCL exceeds the MDC, then the MDC is used for the EPC. Tier 1 EPC for 2,3,7,8-TCDD TEQ is used as the Tier 2 EPC, because all dioxin/furan samples were collected from one 30-acre grid..

[f] The TEQ for 2,3,7,8-TCDD is calculated in Table 1.8.

Table 3.2
Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Worker

| Exposure Route/Exposure Factor | Abbreviation | Value | Units | Source |
|---|---|---|---|---|
| **Ingestion** | | | | |
| **CI = (Cs x IRwss x EFwss x EDw x CF_3) / (BW x [ATc_wss or ATn_wss]b)** | | | | |
| Chemical Intake | CI | chemical-specific | mg/kg-day | calculated |
| Chemical concentration in soil | Cs | chemical-specific | mg/kg | Tier 1 or 2 EPC |
| Ingestion Rate of soil/sediment | IRwss | 100 | mg/day | EPA et al. 2002 |
| Exposure Frequency | EFwss | 230 | days/year | EPA et al. 2002 |
| Exposure Duration | EDw | 18.7 | yr | EPA et al. 2002 |
| Conversion Factor | CF_3 | 1.00E-06 | kg/mg | 1 kg = 1.0E6 mg |
| Adult Body Weight | BW | 70 | kg | EPA 1991 |
| Averaging Time-Carcinogenic | ATc_wss | 25,550 | day | calculated |
| Averaging Time-Noncarcinogenic | ATnc_wss | 6,826 | day | calculated |
| | | | | |
| **Outdoor Inhalation of Suspended Particulates** | | | | |
| **CI = (Cs x IRawss x EFwss x EDw x ETwss x ETFo x MLF) / (BW x [ATc_wss or ATn_wss][b])** | | | | |
| Chemical Intake | CI | chemical-specific | mg/kg-day | calculated |
| Chemical concentration in soil | Cs | chemical-specific | mg/kg | Tier 1 or 2 EPC |
| Inhalation Rate | IRawss | 1.30 | $m^3$/hr | EPA et al. 2002 |
| Exposure Frequency | EFwss | 230 | days/year | EPA et al. 2002 |
| Exposure Duration | EDw | 18.7 | yr | EPA et al. 2002 |
| Exposure Time | ETwss | 8 | hr/day | EPA et al. 2002 |
| Exposure Time Fraction, outdoor | ETFo | 0.500 | -- | EPA et al. 2002 |
| Mass loading, (PM 10) for inhalation[a] | MLF | 6.70E-08 | kg/$m^3$ | EPA et al. 2002 |
| Adult Body Weight | BW | 70 | kg | EPA 1991 |
| Averaging Time-Carcinogenic | ATc_wss | 25,550 | day | calculated |
| Averaging Time-Noncarcinogenic | ATnc_wss | 6,826 | day | calculated |
| | | | | |
| **Indoor Inhalation of Suspended Particulates** | | | | |
| **CI = (Cs x IRawss x EFwss x EDw x ETwss x ETFi x DFi x MLF) / (BW x [ATc_wss or ATn_wss][b])** | | | | |
| Chemical Intake | CI | chemical-specific | mg/kg-day | calculated |
| Chemical concentration in soil | Cs | chemical-specific | mg/kg | Tier 1 or 2 EPC |
| Inhalation Rate | IRawss | 1.30 | $m^3$/hr | EPA et al. 2002 |
| Exposure Frequency | EFwss | 230 | days/year | EPA et al. 2002 |
| Exposure Duration | EDw | 18.7 | yr | EPA et al. 2002 |
| Exposure Time | ETwss | 8 | hr/day | EPA et al. 2002 |
| Exposure Time Fraction, indoor | ETFi | 0.500 | -- | EPA et al. 2002 |

**Table 3.2**
**Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Worker**

| Exposure Route/Exposure Factor | Abbreviation | Value | Units | Source |
|---|---|---|---|---|
| Dilution Factor, indoor inhalation | DFi | 0.700 | -- | EPA et al. 2002 |
| Mass Loading, (PM 10) for inhalation[a] | MLF | 6.70E-08 | $kg/m^3$ | EPA et al. 2002 |
| Adult Body Weight | BW | 70 | kg/m3 | EPA 1991 |
| Averaging Time-Carcinogenic | ATc_wss | 25,550 | day | calculated |
| Averaging Time-Noncarcinogenic | ATnc_wss | 6,826 | day | calculated |
| **Dermal Contact** | | | | |
| **CI = (Cs x SAw x AFw x EFwss x EDw x ABS x EVw x CF) / (BW x [Atc_wss or Atn_wss][b])** | | | | |
| Chemical Intake | CI | chemical-specific | mg/kg-day | calculated |
| Chemical concentration in soil | Cs | chemical-specific | mg/kg | Tier 1 or 2 EPC |
| Skin Surface Area[c] | SAw | 3,300 | $cm^2$ | EPA 2001 |
| Skin-soil adherence factor | AFw | 0.117 | $mg/cm^2$-event | EPA 2001 |
| Exposure Frequency | EFwss | 230 | days/year | EPA et al. 2002 |
| Exposure Duration | EDw | 18.7 | yr | EPA et al. 2002 |
| Conversion Factor | CF_3 | 1.00E-06 | kg/mg | 1 kg = 1.0E6 mg |
| Absorption Fraction | ABS | chemical-specific | | EPA 2001[c] |
| Event frequency | EVw | 1 | events/day | EPA 2001 |
| Adult Body Weight | BW | 70 | kg | EPA 1991 |
| Averaging Time-Carcinogenic | ATc_wss | 25,550 | day | calculated |
| Averaging Time-Noncarcinogenic | ATnc_wss | 6,826 | day | calculated |

[a] The mass loading value is the 95th percentile of the estimated mass loading distribution estimated in the RSALs Task 3 Report (EPA et al. 2002).

[b] Carcinogenic or noncarcinogenic averaging times (Atc and Atnc, respectively) are used in equations, depending on whether carcinogenic or noncarcinogenic intakes are being calculated.

[c] The skin surface area value is the EPA default for commercial/industrial exposures and is the average of the 50th percentile for men and women > 18 years old wearing a short-sleeved shirt, long pants, and shoes. The value was recommended by CDPHE for use in the WRW PRGs.

**Table 3.3**
**Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Visitor**

| Exposure Route/Exposure Factor | Abbreviation | Value | Units | Source |
|---|---|---|---|---|
| **Ingestion** | | | | |
| **CI = (Cs x IRagevss x EFvss x CF_3) / [Atc_vss or Atnc][a]**<br>**where, IRageav = ((IRvss x EDav) / BW) + ((IRcvss x EDcv) / BWc)** | | | | |
| Chemical Intake | CI | chemical-specific | mg/kg-day | calculated |
| Chemical concentration in soil | Cs | chemical-specific | mg/kg | Tier 1 or 2 EPC |
| Age-adjusted Soil Ingestion Rate for chemicals | IRagevss | 57.1 | mg-yr/kg-day | calculated |
| Exposure Frequency | EFvss | 100 | days/year | EPA et al. 2002[b] |
| Exposure Duration - adult | EDav | 24 | yr | EPA et al. 2002 |
| Exposure Duration - child | EDcv | 6 | yr | EPA et al. 2002 |
| Conversion Factor | CF_3 | 1.00E-06 | kg/mg | 1 kg = 1.0E6 mg |
| Soil Ingestion Rate - adult | IRvss | 50 | mg/day | EPA et al. 2002 |
| Soil Ingestion Rate - child | IRcvss | 100 | mg/day | EPA et al. 2002 |
| Adult Body Weight | BW | 70 | kg | EPA 1991 |
| Child Body Weight | BWc | 15 | kg | EPA 1991 |
| Averaging Time-Carcinogenic | ATc_vss | 25,550 | day | calculated |
| Averaging Time-Noncarcinogenic | ATn_vss | 8,760 | day | calculated |
| Averaging Time-Noncarcinogenic (child) | ATn_c_vss | 2,190 | day | calculated |
| Averaging Time-Noncarcinogenic (child+adult) | ATnc | 10,950 | day | calculated |
| | | | | |
| **Outdoor Inhalation of Suspended Particulates** | | | | |
| **CI = (Cs x IRa_agevss x EFvss x MLF) / [Atc_vss or Atnc][a]**<br>**where, IRa_agevss = (((Ira_vss x EDav) / BW) + ((IRa_cvss x EDcv) / BWc)) x ET** | | | | |
| Chemical Intake | NRI | chemical-specific | mg/kg-day | calculated |
| Chemical concentration in soil | Cs | chemical-specific | mg/kg | EPC |
| Age-averaged Inhalation Rate for chemicals | IRa_agevss | 3.66 | $m^3$-yr/kg-day | EPA et al. 2002[b] |
| Exposure Frequency | EFvss | 100 | days/year | EPA et al. 2002[b] |
| Mass loading, (PM 10) for inhalation | MLF | 6.70E-08 | kg/$m^3$ | EPA et al. 2002 |
| Exposure Duration - adult | EDav | 24 | yr | EPA et al. 2002 |
| Exposure Duration - child | EDcv | 6 | yr | EPA et al. 2002 |
| Adult Body Weight | BW | 70 | kg | EPA 1991 |
| Child Body Weight | BWc | 15 | kg | EPA 1991 |
| Air Inhalation Rate - adult | IRavss | 2.40 | $m^3$/hr | EPA et al. 2002 |
| Air Inhalation Rate - child | IRa_cvss | 1.60 | $m^3$/hr | EPA et al. 2002 |
| Exposure Time | Etvss | 2.50 | hr/day | EPA et al. 2002[b] |

**Table 3.3**
**Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Visitor**

| Exposure Route/Exposure Factor | Abbreviation | Value | Units | Source |
|---|---|---|---|---|
| Averaging Time-Carcinogenic | ATc_vss | 25,550 | day | calculated |
| Averaging Time-Noncarcinogenic | ATn_vss | 8,760 | day | calculated |
| Averaging Time-Noncarcinogenic (child) | ATn_c_vss | 2,190 | day | calculated |
| Averaging Time-Noncarcinogenic (child+adult) | ATnc | 10,950 | day | calculated |
| **Dermal Contact** | | | | |
| **CI = (Cs x SFSagav x EFvss x ABS x EVv x CF_3) /[Atc_vss or ATnc][a]** where, SFSagav = ((Saav x Afav xEDav) / BW) + ((Sacv x Afcv x EDcv) / BWc) | | | | |
| Chemical Intake | CI | chemical-specific | mg/kg-day | calculated |
| Chemical concentration in soil | Cs | chemical-specific | mg/kg | Tier 1 or 2 EPC |
| Exposure Frequency | EFvss | 100 | days/year | EPA et al. 2002[b] |
| Exposure Duration - adult | EDav | 24 | yr | EPA et al. 2002 |
| Exposure Duration - child | EDcv | 6 | yr | EPA et al. 2002 |
| Adult skin-soil adherence factor | Afav | 0.0700 | $mg/cm^2$-event | EPA 2001b[c] |
| Child skin-soil adherence factor | Afcv | 0.200 | $mg/cm^2$-event | EPA 2001b[d] |
| Adult skin surface area (exposed) | Saav | 5,700 | $cm^2$ | EPA 2001b[e] |
| Child skin surface area (exposed) | Sacv | 2,800 | $cm^2$ | EPA 2001b[f] |
| Age-averaged surface area/adherence factor | SFSagav | 361 | mg-yr/kg-event | EPA 2001b |
| Absorption Fraction | ABS | chemical-specific | | EPA 2001b |
| Event frequency | EVv | 1 | events/day | EPA 2001 |
| Conversion Factor | CF_3 | 1.00E-06 | kg/mg | 1 kg = 1.0E6 mg |
| Adult Body Weight | Bw | 70 | kg | EPA 1991 |
| Child Body Weight | BWc | 15 | kg | EPA 1991 |
| Averaging Time-Carcinogenic | ATc_vss | 25,550 | day | calculated |
| Averaging Time-Noncarcinogenic | ATn_vss | 8,760 | day | calculated |
| Averaging Time-Noncarcinogenic (child) | ATn_c_vss | 2,190 | day | calculated |
| Averaging Time-Noncarcinogenic (child+adult) | ATnc | 10,950 | day | calculated |

[a] Carcinogenic or noncarcinogenic averaging times (Atc and Atnc, respectively) are used in equations, depending on whether carcinogenic or noncarcinogenic intakes are being calculated.

[b] Value is the 50th percentile of time spent for open space users (Jefferson County 1996).

[c] The adult skin-soil adherence factor is the EPA residential default and the 50$^{th}$ percentile forgardeners. This is the value recommended by CDPHE for use in the WRW PRGs.

**Table 3.3**
**Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Visitor**

| Exposure Route/Exposure Factor | Abbreviation | Value | Units | Source |
|---|---|---|---|---|

[d] The child skin-soil adherence factor is the EPA residential default and the 95th percentile for children playing in wet soil. This is the value recommended by CDPHE for use in the open space user PRGs.
[e] The adult skin-surface area value is the EPA default for residential exposures and the average of the 50th percentile for males and females > 18 years old wearing short-sleeved shirts, shorts, and shoes. The value was recommended by CDPHE for use in the WRW PRGs.

[f] The child skin-surface area value is the EPA default for residential exposures and the average of the 50th percentiles for males and females from <1 to <6 years old wearing short-sleeved shirts, shorts, and no shoes. The value was recommended by CDPHE for use in the WRW PRGs.

**Table 4.1**
**Chemical Cancer Slope Factors, Weight of Evidence, and Target Organs for COCs**

| Contaminant of Concern[c] | CAS Number | Oral Slope Factor $(mg/kg\text{-}day)^{-1}$ | Source | Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$ | Source | Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$ | Source | Weight of Evidence[a] | Dermal Absorption Fraction[b] | Target Organ/Cancer | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Benzo(a)pyrene | 50-32-8 | 7.3 | I | 7.3 | O | 0.31 | P | B2 | 0.13 | Tumors | A |
| 2,3,7,8-TCDD TEQ | 1746-01-6 | 150,000 | H | 150,000 | O | 150,000 | H | B2 | 0.03 | Liver | I |

[a] See Table 5.1 in the CRA Methodology (DOE 2005) for definitions of Weight of Evidence classifications

[b] Dermal ABS from EPA 2001

[c] The TEQ for 2,3,7,8-TCDD is calculated in Table 1.8 and the toxicity criteria for 2,3,7,8-TCDD is used.

A = Agency for Toxic Substances and Disease Registry online database, http://www.atsdr.cdc.gov
H = HEAST (EPA 1997a)
I - IRIS (EPA 2004a)
O = Oral slope factor used.
P = EPA-NCEA Provisional value (EPA 2004)

Table 4.2
Chemical Non-Cancer Reference Doses, Target Organs, and Effects for COCs

| Contaminant of Concern[b] | CAS Number | Oral RfD (mg/kg-day) | Source | Dermal RfD (mg/kg-day) | Source | Inhalation RfD (mg/kg-day) | Source | Dermal Absorption Fraction[a] | Target Organ/Effect | Source |
|---|---|---|---|---|---|---|---|---|---|---|
| Benzo(a)pyrene | 50-32-8 | N/A | N/A | N/A | N/A | N/A | N/A | 0.13 | N/A | N/A |
| 2,3,7,8-TCDD TEQ | 1746-01-6 | N/A | N/A | N/A | N/A | N/A | N/A | 0.03 | N/A | N/A |

[a] Dermal ABS from EPA 2001

[b] The TEQ for 2,3,7,8-TCDD is calculated in Table 1.8 and the toxicity criteria for 2,3,7,8-TCDD is used.

N/A = Not available or not applicable.

Table 5.1

Summary of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Worker

| EPC/Medium/ Contaminant of Concern | Chemical Cancer Risk | | | | | Non-Cancer Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ingestion | Inhalation | Dermal | Exposure Routes Total | Percent Contribution to Risk | Ingestion | Inhalation | Dermal | Exposure Routes Total | Percent Contribution to Hazard Index |
| Tier 1 | | | | | | | | | | |
| Surface Soil/Surface Sediment | | | | | | | | | | |
| 2,3,7,8-TCDD TEQ | 1.97E-06 | 1.17E-08 | 2.28E-07 | 2.21E-06 | 27% | NC | NC | NC | NC | NC |
| Benzo(a)pyrene | 3.95E-06 | 9.93E-10 | 1.98E-06 | 5.93E-06 | 73% | NC | NC | NC | NC | NC |
| **Surface Soil/Surface Sediment Total:** | | | | **8.14E-06** | **100%** | | | | **NC** | **NC** |
| **Tier 1 WRW Total:** | | | | **8E-06** | | | | | **NC** | |
| Tier 2 | | | | | | | | | | |
| Surface Soil/Surface Sediment | | | | | | | | | | |
| 2,3,7,8-TCDD TEQ | 1.97E-06 | 1.17E-08 | 2.28E-07 | 2.21E-06 | 71% | NC | NC | NC | NC | NC |
| Benzo(a)pyrene | 6.01E-07 | 1.51E-10 | 3.02E-07 | 9.03E-07 | 29% | NC | NC | NC | NC | NC |
| **Surface Soil/Surface Sediment Total:** | | | | **3.11E-06** | **100%** | | | | **NC** | **NC** |
| **Tier 2 WRW Total:** | | | | **3E-06** | | | | | **NC** | |

-- : Exposure route is not complete because no COCs identified or exposure route was identified as insignificant in the CRA Methodology.
NC = Not calculated, noncancer toxicity criteria were not available.

Table 5.2
Summary of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Visitor

| EPC/Medium/ Contaminant of Concern | Chemical Cancer Risk | | | | | Non-Cancer Hazard Quotient | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ingestion | Inhalation | Dermal | Exposure Routes Total | Percent Contribution to Risk | Ingestion | Inhalation | Dermal | Exposure Routes Total | Percent Contribution to Hazard Index |
| **Tier 1** | | | | | | | | | | |
| **Surface Soil/Surface Sediment** | | | | | | | | | | |
| 2,3,7,8-TCDD TEQ | 1.83E-06 | 7.86E-09 | 3.47E-07 | 2.19E-06 | 25% | NC | NC | NC | NC | NC |
| Benzo(a)pyrene | 3.67E-06 | 6.69E-10 | 3.02E-06 | 6.69E-06 | 75% | NC | NC | NC | NC | NC |
| **Surface Soil/Surface Sediment Total:** | | | | **8.88E-06** | **100%** | | | | **NC** | **NC** |
| **Tier 1 WRV Total:** | | | | **9E-06** | | | | | **NC** | |
| **Tier 2** | | | | | | | | | | |
| **Surface Soil/Surface Sediment** | | | | | | | | | | |
| 2,3,7,8-TCDD TEQ | 1.83E-06 | 7.86E-09 | 3.47E-07 | 2.19E-06 | 68% | NC | NC | NC | NC | NC |
| Benzo(a)pyrene | 5.59E-07 | 1.02E-10 | 4.59E-07 | 1.02E-06 | 32% | NC | NC | NC | NC | NC |
| **Surface Soil/Surface Sediment Total:** | | | | **3.21E-06** | **100%** | | | | **NC** | **NC** |
| **Tier 2 WRV Total:** | | | | **3E-06** | | | | | **NC** | |

-- : Exposure route is not complete because no COCs identified or exposure route was identified as insignificant in the CRA Methodology.
NC = Not calculated, noncancer toxicity criteria were not available.

## Table 5.3
## Summary of Risk Characterization Results

| Exposure Scenario/EPC/Medium | Estimated Excess Lifetime Cancer Risk | Major Contributors to Chemical Cancer Risk | Estimated Non-Cancer Hazard Quotient | Major Contributors to Hazard Quotient |
|---|---|---|---|---|
| **Wildlife Refuge Worker (WRW)** | | | | |
| **Tier 1 EPC** | | | | |
| Surface Soil/Surface Sediment | 8E-06 | 2,3,7,8-TCDD TEQ (27%) | NC | N/A |
| | | Benzo(a)pyrene (73%) | | |
| **Tier 2 EPC** | | | | |
| Surface Soil/Surface Sediment | 3E-06 | 2,3,7,8-TCDD TEQ (71%) | NC | N/A |
| | | Benzo(a)pyrene (29%) | | |
| **Wildlife Refuge Visitor (WRV)** | | | | |
| **Tier 1 EPC** | | | | |
| Surface Soil/Surface Sediment | 9E-06 | 2,3,7,8-TCDD TEQ (25%) | NC | N/A |
| | | Benzo(a)pyrene (75%) | | |
| **Tier 2 EPC** | | | | |
| Surface Soil/Surface Sediment | 3E-06 | 2,3,7,8-TCDD TEQ (68%) | NC | N/A |
| | | Benzo(a)pyrene (32%) | | |

NC = Not calculated, noncancer toxicity criteria were not available.

N/A = Not applicable

**Table 6.1**

**Detected PCOCs without PRGs in Each Medium by Analyte Suite[a]**

| Analyte | Surface Soil/ Surface Sediment | Subsurface Soil/ Subsurface Sediment |
|---|---|---|
| **Inorganics** | | |
| Cesium | X | X |
| Phosphorus | N/A | X |
| Silica | X[b] | X[b] |
| Silicon | X[b] | X |
| Total Petroleum Hydrocarbons | N/A | X |
| **Organics** | | |
| 4-Chloro-3-methylphenol | N/A | X |
| Acenaphthylene | X | X |
| Benzo(g,h,i)perylene | X | X |
| Phenanthrene | X | X |
| **Radionuclides** | | |
| Gross Alpha | X | X |
| Gross Beta | X | X |

[a] Does not include essential nutrients or Dioxin/Furan congeners. Essential nutrients without PRGs were evaluated by comparing estimated intakes to recommended intakes. Dioxin and Furan congeners were evaluated by calculating the 2,3,7,8-TCDD Equivalents (TEQ), which are presented in Table 1.8.

b All detections are "J" qualified,; signifying that the reported resultis below the detection limit, but above the instrument detection limit.

X indicates PRG is unavailable.

N/A = Not applicable. Analyte not detected or not analyzed.

Table 7.1

Comparison of MDCs in Surface Soil to NOAEL ESLs for Terrestrial Plants, Invertebrates and Vertebrates in the UWOEU

| Analyte | MDC | Terrestrial Plants | | Terrestrial Invertebrates | | Mourning Dove Herbivore | | Mourning Dove Insectivore | | American Kestrel | | Deer Mouse Herbivore | | Deer Mouse Insectivore | | Prairie Dog | | Mule Deer | | Coyote Carnivore | | Coyote Generalist | | Coyote Insectivore | | Terrestrial Receptor[a] | | Most Sensitive Receptor | Retain for Further Analysis? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | Results | |
| Inorganics (mg/kg) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | 30,000 | 50 | Yes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | Terrestrial Plant | Yes |
| Ammonia | 4.40 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 7,320 | No | 586 | No | 26,700 | No | 37,000 | No | 2,250 | No | 2,310 | No | 2,540 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Antimony | 49.8 | 5 | Yes | 78 | No | N/A | N/A | N/A | N/A | N/A | N/A | 9.89 | Yes | 0.905 | Yes | 18.7 | Yes | 57.6 | No | 138 | No | 13.2 | Yes | 3.85 | Yes | N/A | N/A | Deer Mouse Insectivore | Yes |
| Arsenic | 10 | 10 | Yes | 60 | No | 20.0 | No | 164 | No | 1,030 | No | 2.57 | Yes | 51.4 | No | 9.35 | Yes | 13.0 | No | 709 | No | 341 | No | 293 | No | N/A | N/A | Deer Mouse Herbivore | Yes |
| Barium | 464 | 500 | No | 330 | Yes | 159 | Yes | 357 | Yes | 1,320 | No | 930 | No | 4,430 | No | 3,220 | No | 4,770 | No | 24,900 | No | 19,800 | No | 18,400 | No | N/A | N/A | Mourning Dove Herbivore | Yes |
| Beryllium | 4.40 | 10 | No | 40 | No | N/A | N/A | N/A | N/A | N/A | N/A | 160 | No | 6.82 | No | 211 | No | 896 | No | 1,070 | No | 103 | No | 29.2 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Boron | 11 | 0.500 | Yes | N/A | N/A | 30.3 | No | 115 | No | 167 | No | 62.1 | No | 422 | No | 237 | No | 314 | No | 929 | No | 6,070 | No | 1,820 | No | N/A | N/A | Terrestrial Plant | Yes |
| Cadmium | 30 | 32 | No | 140 | No | 28.1 | Yes | 0.705 | Yes | 15.0 | Yes | 59.9 | No | 1.56 | Yes | 198 | No | 723 | No | 1,360 | No | 51.2 | No | 9.75 | Yes | N/A | N/A | Mourning Dove Insectivore | Yes |
| Calcium | 69,700 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Cesium | 16.4 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Chromium[b] | 61 | 1 | Yes | 0.400 | Yes | 24.6 | Yes | 1.34 | Yes | 14.0 | Yes | 281 | No | 15.9 | Yes | 703 | No | 1,460 | No | 4,170 | No | 250 | No | 68.5 | No | N/A | N/A | Terrestrial Invertebrate | Yes |
| Cobalt | 13.7 | 13 | Yes | N/A | N/A | 278 | No | 87.0 | No | 440 | No | 1,480 | No | 363 | No | 2,460 | No | 7,900 | No | 3,790 | No | 2,490 | No | 1,520 | No | N/A | N/A | Terrestrial Plant | Yes |
| Copper | 330 | 100 | Yes | 50 | Yes | 28.9 | Yes | 8.25 | Yes | 164 | Yes | 295 | Yes | 605 | No | 838 | No | 4,120 | No | 5,460 | No | 3,000 | No | 4,640 | No | N/A | N/A | Mourning Dove Insectivore | Yes |
| Iron | 29,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Lead | 220 | 110 | Yes | 1,700 | No | 49.9 | Yes | 12.1 | Yes | 95.8 | Yes | 1,340 | No | 242 | No | 1,850 | No | 9,800 | No | 8,930 | No | 3,070 | No | 1,390 | No | N/A | N/A | Mourning Dove Insectivore | Yes |
| Lithium | 20 | 2 | Yes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1,880 | No | 610 | No | 3,180 | No | 10,200 | No | 18,400 | No | 5,610 | No | 2,560 | No | N/A | N/A | Plant | Yes |
| Magnesium | 5,610 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Manganese | 829 | 500 | Yes | N/A | N/A | 1,030 | No | 2,631 | No | 9,920 | No | 486 | Yes | 4,080 | No | 1,520 | No | 2,510 | No | 14,050 | No | 10,900 | No | 19,100 | No | N/A | N/A | Deer Mouse Herbivore | Yes |
| Mercury | 2.40 | 0.300 | Yes | 0.100 | Yes | 0.197 | Yes | 1.00E-04 | Yes | 1.57 | Yes | 0.439 | Yes | 0.179 | Yes | 3.15 | No | 7.56 | No | 8.18 | No | 8.49 | No | 37.3 | No | N/A | N/A | Mourning Dove Insectivore | Yes |
| Molybdenum | 5.90 | 2 | Yes | N/A | N/A | 44.4 | No | 6.97 | No | 76.7 | No | 8.68 | No | 1.90 | Yes | 27.1 | No | 44.3 | No | 275 | No | 28.9 | No | 8.18 | No | N/A | N/A | Deer Mouse Insectivore | Yes |
| Nickel | 48 | 30 | Yes | 200 | No | 44.1 | Yes | 1.24 | Yes | 13.1 | Yes | 16.4 | Yes | 0.431 | Yes | 38.3 | Yes | 124 | No | 90.9 | No | 6.02 | Yes | 1.86 | Yes | N/A | N/A | Deer Mouse Insectivore | Yes |
| Nitrate / Nitrite[c] | 3.63 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 4,478 | No | 7,650 | No | 16,200 | No | 22,700 | No | 32,879 | No | 32,200 | No | 32,900 | No | N/A | N/A | Deer Mouse Herbivore | No |
| Potassium | 4,460 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Selenium | 1 | 1 | Yes | 70 | No | 1.61 | No | 1 | Yes | 8.48 | No | 0.872 | Yes | 0.754 | Yes | 2.80 | No | 3.82 | No | 32.5 | No | 12.2 | No | 5.39 | No | N/A | N/A | Deer Mouse Insectivore | Yes |
| Silica | 1,200 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Silicon | 1,560 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Silver | 98 | 2 | Yes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | Terrestrial Plant | Yes |
| Sodium | 474 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Strontium | 150 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 940 | No | 13,600 | No | 3,520 | No | 4,700 | No | 584,000 | No | 145,000 | No | 57,300 | No | N/A | N/A | Deer Mouse Herbivore | No |
| Thallium | 0.960 | 1 | No | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 180 | No | 7.24 | No | 204 | No | 1,040 | No | 212 | No | 81.6 | No | 30.8 | No | N/A | N/A | Terrestrial Plant | No |
| Tin | 66.9 | 50 | Yes | N/A | N/A | 26.1 | Yes | 2.90 | Yes | 19.0 | Yes | 45.0 | Yes | 3.77 | Yes | 80.6 | No | 242 | No | 70.0 | No | 36.1 | Yes | 16.2 | Yes | N/A | N/A | Mourning Dove Insectivore | Yes |
| Titanium | 410 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Uranium | 85 | 5 | Yes | N/A | N/A | 685 | No | 446 | No | 2,790 | No | 970 | No | 569 | No | 1,230 | No | 5,470 | No | 7,300 | No | 3,110 | No | 2,270 | No | N/A | N/A | Terrestrial Plant | Yes |
| Vanadium | 54.8 | 2 | Yes | N/A | N/A | 503 | No | 274 | No | 1,510 | No | 63.7 | No | 29.9 | Yes | 83.5 | No | 358 | No | 341 | No | 164 | No | 121 | No | N/A | N/A | Terrestrial Plant | Yes |
| Zinc | 650 | 50 | Yes | 200 | Yes | 109 | Yes | 0.646 | Yes | 113 | Yes | 171 | Yes | 5.29 | Yes | 1,170 | No | 2,770 | No | 16,500 | No | 3,890 | No | 431 | Yes | N/A | N/A | Mourning Dove Insectivore | Yes |
| Organics (µg/kg) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1,2,4-Trichlorobenzene | 0.950 | N/A | N/A | 20,000 | No | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | Terrestrial Invertebrate | No |
| 1,2,4-Trimethylbenzene | 1.50 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| 2-Butanone | 3 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| 2-Methylnaphthalene | 12,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 92,700 | No | 2,770 | Yes | 319,000 | No | 471,000 | No | 12,300 | No | 12,200 | No | 12,000 | Yes | N/A | N/A | Deer Mouse Insectivore | Yes |
| 4,4'-DDT | 21 | N/A | N/A | N/A | N/A | 226 | No | 1.20 | Yes | 3.34 | Yes | 72,100 | No | 379 | No | 176,000 | No | 375,000 | No | 1,870 | No | 1,810 | No | 1,640 | No | N/A | N/A | Mourning Dove Insectivore | Yes |
| 4-Methyl-2-pentanone | 4 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 238,000 | No | 14,600 | No | 859,000 | No | 1.20E+06 | No | 58,400 | No | 59,600 | No | 63,400 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Acenaphthene | 44,000 | 20,000 | Yes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | Terrestrial Plant | Yes |
| Acenaphthalene | 600 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Acetone | 11 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 67,500 | No | 6,180 | No | 248,000 | No | 341,000 | No | 23,200 | No | 24,000 | No | 26,800 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Aldrin | 17 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 3,620 | No | 47 | No | 11,300 | No | 18,500 | No | 233 | No | 225 | No | 204 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Anthracene | 47,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Benzene | 1.20 | 500 | No | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 30,700 | No | 14,900 | No | 1.10E+06 | No | 1.56E+06 | No | 61,800 | No | 62,400 | No | 64,700 | No | N/A | N/A | Terrestrial Plant | No |
| Benzo(a)anthracene | 45,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Benzo(a)pyrene | 43,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 337,000 | No | 631 | Yes | 503,000 | No | 2.41E+06 | No | 3,060 | Yes | 2,970 | Yes | 2,760 | Yes | N/A | N/A | Deer Mouse Insectivore | Yes |
| Benzo(b)fluoranthene | 49,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Benzo(g,h,i)perylene | 28,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Benzo(k)fluoranthene | 25,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Benzoic Acid | 770 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Benzyl Alcohol | 270 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 70,000 | No | 4,400 | No | 253,000 | No | 354,000 | No | 17,500 | No | 17,900 | No | 19,100 | No | N/A | N/A | Deer Mouse Insectivore | No |
| bis(2-ethylhexyl)phthalate | 3,500 | N/A | N/A | N/A | N/A | 19,500 | No | 137 | Yes | 398 | Yes | 960,000 | No | 8,070 | No | 2.76E+06 | No | 4.93E+06 | No | 42,300 | No | 40,200 | No | 35,000 | No | N/A | N/A | Mourning Dove Insectivore | Yes |
| Butylbenzylphthalate | 220 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1.00E+06 | No | 24,200 | No | 3.37E+06 | No | 5.08E+06 | No | 110,000 | No | 109,000 | No | 105,000 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Carbazole | 39 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Chrysene | 46,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Di-n-butylphthalate | 200 | 200,000 | No | N/A | N/A | 989 | No | 15.9 | Yes | 41.5 | Yes | 1.21E+07 | No | 281,000 | No | 4.06E+07 | No | 6.13E+07 | No | 1.29E+06 | No | 1.27E+06 | No | 1.22E+06 | No | N/A | N/A | Mourning Dove Insectivore | Yes |
| Di-n-octylphthalate | 83 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 9.05E+07 | No | 731,000 | No | 2.58E+08 | No | 4.65E+08 | No | 3.85E+06 | No | 3.65E+06 | No | 3.17E+06 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Dibenz(a,h)anthracene | 9,200 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Dibenzofuran | 20,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 707,000 | No | 21,200 | No | 2.44E+06 | No | 3.59E+06 | No | 93,800 | No | 93,200 | No | 91,800 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Dieldrin | 34 | N/A | N/A | N/A | N/A | 178 | No | 9.87 | Yes | 25.7 | Yes | 81.4 | No | 7.40 | Yes | 301 | No | 411 | No | 33.6 | Yes | 33.2 | Yes | 32 | Yes | N/A | N/A | Deer Mouse Insectivore | Yes |
| Total Dioxin | 1.31 | N/A | N/A | N/A | N/A | 0.194 | Yes | 0.0134 | Yes | 0.0775 | Yes | 0.0375 | Yes | 0.00425 | Yes | 0.116 | Yes | 0.192 | Yes | 0.0735 | Yes | 0.0339 | Yes | 0.01460 | Yes | N/A | N/A | Deer Mouse Insectivore | Yes |
| Endosulfan sulfate | 24 | N/A | N/A | N/A | N/A | 71,400 | No | 1,510 | No | 3,810 | No | 2,520 | No | 80.1 | No | 8,730 | No | 12,800 | No | 352 | No | 350 | No | 347 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Endrin ketone | 36 | N/A | N/A | N/A | N/A | 106 | No | 1.40 | Yes | 3.74 | Yes | 2,460 | No | 45.5 | No | 8,060 | No | 12,500 | No | 215 | No | 210 | No | 197 | No | N/A | N/A | Mourning Dove Insectivore | Yes |
| Fluoranthene | 140,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Fluorene | 39,000 | 200,000 | No | 30,000 | Yes | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | Terrestrial Invertebrate | Yes |
| Heptachlor epoxide | 10 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 2,710 | No | 64 | No | 9,120 | No | 13,800 | No | 293 | No | 289 | No | 277 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Indeno(1,2,3-cd)pyrene | 32,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Isophorone | 96 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Methoxychlor | 450 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 70,500 | No | 1,230 | No | 22,900 | No | 35,900 | No | 5,840 | No | 5,690 | No | 5,310 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Methylene Chloride | 2 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 58,200 | No | 3,400 | No | 210,000 | No | 295,000 | No | 13,700 | No | 13,900 | No | 14,700 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Naphthalene | 41,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 8.08E+06 | No | 27,100 | Yes | 1.60E+07 | No | 5.57E+07 | No | 104,000 | No | 107,000 | No | 118,000 | No | N/A | N/A | Deer Mouse Insectivore | Yes |
| Total PCBs | 3,900 | 40,000 | No | N/A | N/A | 1,140 | Yes | 172 | Yes | 886 | Yes | 11,900 | No | 1,240 | Yes | 38,000 | No | 61,300 | No | 5,190 | No | 3,320 | Yes | 3,680 | Yes | N/A | N/A | Mourning Dove Insectivore | Yes |

**Table 7.1**

**Comparison of MDCs in Surface Soil to NOAEL ESLs for Terrestrial Plants, Invertebrates and Vertebrates in the UWOEU**

| Analyte | MDC | Terrestrial Plants | | Terrestrial Invertebrates | | Mourning Dove Herbivore | | Mourning Dove Insectivore | | American Kestrel | | Deer Mouse Herbivore | | Deer Mouse Insectivore | | Prairie Dog | | Mule Deer | | Coyote Carnivore | | Coyote Generalist | | Coyote Insectivore | | Terrestrial Receptor[a] | | Most Sensitive Receptor | Retain for Further Analysis? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | NOAEL | MDC > ESL? | Results | |
| Phenanthrene | 170,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Phenol | 80 | 70,000 | No | 30,000 | No | N/A | N/A | N/A | N/A | N/A | N/A | 41,500 | No | 23,100 | No | 1.49E+06 | No | 2.10E+06 | No | 93,600 | No | 95,100 | No | 100,000 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Pyrene | 120,000 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Tetrachloroethene | 6 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Toluene | 310 | 200,000 | No | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 347,000 | No | 14,400 | No | 1.22E+06 | No | 1.76E+06 | No | 61,000 | No | 61,300 | No | 62,500 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Xylene[d] | 2.90 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 32,000 | No | 1,140 | No | 11,200 | No | 16,200 | No | 4,930 | No | 4,930 | No | 4,940 | No | N/A | N/A | Deer Mouse Insectivore | No |
| Radionuclides (pCi/g) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Americium-241 | 0.802 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 3,890 | No | Terrestrial Receptors | No |
| Cesium-137 | 1 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 20.8 | No | Terrestrial Receptors | No |
| Gross Alpha | 113 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Gross Beta | 305 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Neptunium-237 | 0.00224 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Plutonium-238 | 0.0253 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | UT |
| Plutonium-239/240 | 5.01 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 6,110 | No | Terrestrial Receptors | No |
| Radium-226 | 1.09 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 50.6 | No | Terrestrial Receptors | No |
| Radium-228 | 2.29 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 43.9 | No | Terrestrial Receptors | No |
| Uranium-233/234 | 47.5 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 4,980 | No | Terrestrial Receptors | No |
| Uranium-235 | 2.24 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 2,770 | No | Terrestrial Receptors | No |
| Uranium-238 | 209 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1,580 | No | Terrestrial Receptors | No |

[a]Radionuclide ESLs are not receptor-specific. They are considered protective of all terrestrial ecological species.

[b]The ESLs for chromium were developed using available toxicity data based on chromium (III) (birds) and chromium (VI) (plants, invertebrates, and mammals).

[c]The ESLs for nitrate are used.

[d]The value for total xylene is used

N/A = Indicates no ESL was available for that ECOI/receptor pair.

UT = Uncertain toxicity; no ESL available (assessed in Section 10.0).

**Bold = Analyte retained for further consideration in the next ECOPC selection step.**

**Table 7.2**
**Summary of Non-PMJM NOAEL ESL Screening Results for Surface Soil in the UWOEU**

| Analyte | Terrestrial Plant Exceedance? | Terrestrial Invertebrate Exceedance? | Terrestrial Vertebrate Exceedance? |
|---|---|---|---|
| **Inorganics (mg/kg)** | | | |
| **Aluminum** | Yes | UT | UT |
| Ammonia | UT | UT | No |
| **Antimony** | Yes | No | Yes |
| **Arsenic** | Yes | No | Yes |
| **Barium** | No | Yes | Yes |
| Beryllium | No | No | No |
| **Boron** | Yes | UT | No |
| **Cadmium** | No | No | Yes |
| Calcium | UT | UT | UT |
| Cesium | UT | UT | UT |
| **Chromium** | Yes | Yes | Yes |
| **Cobalt** | Yes | UT | No |
| **Copper** | Yes | Yes | Yes |
| Iron | UT | UT | UT |
| **Lead** | Yes | No | Yes |
| **Lithium** | Yes | UT | No |
| Magnesium | UT | UT | UT |
| **Manganese** | Yes | UT | Yes |
| **Mercury** | Yes | Yes | Yes |
| **Molybdenum** | Yes | UT | Yes |
| **Nickel** | Yes | No | Yes |
| Nitrate / Nitrite | UT | UT | No |
| Potassium | UT | UT | UT |
| **Selenium** | Yes | No | Yes |
| Silica | UT | UT | UT |
| Silicon | UT | UT | UT |
| **Silver** | Yes | UT | UT |
| Sodium | UT | UT | UT |
| Strontium | UT | UT | No |
| Thallium | No | UT | No |
| **Tin** | Yes | UT | Yes |
| Titanium | UT | UT | UT |
| **Uranium** | Yes | UT | No |
| **Vanadium** | Yes | UT | Yes |
| **Zinc** | Yes | Yes | Yes |
| **Organics (µg/kg)** | | | |
| 1,2,4-Trichlorobenzene | UT | No | UT |
| 1,2,4-Trimethylbenzene | UT | UT | UT |
| 2-Butanone | UT | UT | UT |
| **2-Methylnaphthalene** | UT | UT | Yes |
| **4,4'-DDT** | UT | UT | Yes |
| 4-Methyl-2-pentanone | UT | UT | No |
| **Acenaphthene** | Yes | UT | UT |
| Acenaphthaltene | UT | UT | UT |
| Acetone | UT | UT | No |
| Aldrin | UT | UT | No |
| Anthracene | UT | UT | UT |

**Table 7.2**

**Summary of Non-PMJM NOAEL ESL Screening Results for Surface Soil in the UWOEU**

| Analyte | Terrestrial Plant Exceedance? | Terrestrial Invertebrate Exceedance? | Terrestrial Vertebrate Exceedance? |
|---|---|---|---|
| Benzene | No | UT | No |
| Benzo(a)anthracene | UT | UT | UT |
| **Benzo(a)pyrene** | UT | UT | **Yes** |
| Benzo(b)fluoranthene | UT | UT | UT |
| Benzo(g,h,i)perylene | UT | UT | UT |
| Benzo(k)fluoranthene | UT | UT | UT |
| Benzoic Acid | UT | UT | UT |
| Benzyl Alcohol | UT | UT | No |
| **bis(2-ethylhexyl)phthalate** | UT | UT | **Yes** |
| Butylbenzylphthalate | UT | UT | No |
| Carbazole | UT | UT | UT |
| Chrysene | UT | UT | UT |
| **Di-n-butylphthalate** | No | UT | **Yes** |
| Di-n-octylphthalate | UT | UT | No |
| Dibenz(a,h)anthracene | UT | UT | UT |
| Dibenzofuran | UT | UT | No |
| **Dieldrin** | UT | UT | **Yes** |
| **Dioxin TEQ (mammals)** | UT | UT | **Yes** |
| **Dioxin TEQ (birds)** | UT | UT | **Yes** |
| Endosulfan sulfate | UT | UT | No |
| **Endrin ketone** | UT | UT | **Yes** |
| Fluoranthene | UT | UT | UT |
| **Fluorene** | No | **Yes** | UT |
| Heptachlor epoxide | UT | UT | No |
| Indeno(1,2,3-cd)pyrene | UT | UT | UT |
| Isophorone | UT | UT | UT |
| Methoxychlor | UT | UT | No |
| Methylene Chloride | UT | UT | No |
| **Naphthalene** | UT | UT | **Yes** |
| **Total PCBs** | No | UT | **Yes** |
| Phenanthrene | UT | UT | UT |
| Phenol | No | No | No |
| Pyrene | UT | UT | UT |
| Tetrachloroethene | UT | UT | UT |
| Toluene | No | UT | No |
| Xylene | UT | UT | No |
| **Radionuclides (pCi/g)** | | | |
| Americium-241 | UT | UT | No |
| Cesium-137 | UT | UT | No |
| Gross Alpha | UT | UT | UT |
| Gross Beta | UT | UT | UT |
| Neptunium-237 | UT | UT | UT |
| Plutonium-238 | UT | UT | UT |
| Plutonium-239/240 | UT | UT | No |
| Radium-226 | UT | UT | No |
| Radium-228 | UT | UT | No |
| Uranium-233/234 | UT | UT | No |
| Uranium-235 | UT | UT | No |
| Uranium-238 | UT | UT | No |

UT - Uncertain toxicity; no ESL available (assessed in Section 10.0).

**Bold = Analyte retained for further consideration in the next ECOPC selection step.**

**Table 7.3**
**Comparison of MDCs in Surface Soil with NOAEL ESLs for the PMJM in the UWOEU**

| Analyte | MDC | PMJM NOAEL ESL | MDC > PMJM ESL? |
|---|---|---|---|
| **Inorganics (mg/kg)** | | | |
| Aluminum | 22,000 | N/A | UT |
| Ammonia | 4.40 | 673 | No |
| **Antimony** | **49.8** | **1** | **Yes** |
| **Arsenic** | **9.90** | **2.21** | **Yes** |
| Barium | 209 | 743 | No |
| Beryllium | 1.70 | 8.16 | No |
| Boron | 8.50 | 52.7 | No |
| **Cadmium** | **4.10** | **1.75** | **Yes** |
| Calcium | 27,000 | N/A | UT |
| Cesium | 16.4 | N/A | UT |
| **Chromium[a]** | **26** | **19.3** | **Yes** |
| Cobalt | 12.4 | 340 | No |
| **Copper** | **112** | **95** | **Yes** |
| Iron | 23,400 | N/A | UT |
| Lead | 40.2 | 220 | No |
| Lithium | 18.5 | 519 | No |
| Magnesium | 5,610 | N/A | UT |
| **Manganese** | **829** | **388** | **Yes** |
| **Mercury** | **0.370** | **0.0521** | **Yes** |
| **Molybdenum** | **4.40** | **1.84** | **Yes** |
| **Nickel** | **26.3** | **0.510** | **Yes** |
| Nitrate / Nitrite[b] | 3.63 | 2,910 | No |
| Potassium | 4,460 | N/A | UT |
| **Selenium** | **1** | **0.421** | **Yes** |
| Silica | 1,200 | N/A | UT |
| Silicon | 798 | N/A | UT |
| Silver | 12.6 | N/A | UT |
| Sodium | 403 | N/A | UT |
| Strontium | 94 | 833 | No |
| Thallium | 0.960 | 8.64 | No |
| **Tin** | **66.9** | **4.22** | **Yes** |
| Titanium | 410 | N/A | UT |
| Uranium | 26 | 370 | No |
| **Vanadium** | **53** | **21.6** | **Yes** |
| **Zinc** | **199** | **6.41** | **Yes** |
| **Organics (µg/kg)** | | | |
| Acenaphthene | 210 | N/A | UT |
| Anthracene | 280 | N/A | UT |
| Benzo(a)anthracene | 780 | N/A | UT |
| Benzo(a)pyrene | 790 | 800 | No |
| Benzo(b)fluoranthene | 1,300 | N/A | UT |
| Benzo(g,h,i)perylene | 83 | N/A | UT |
| Benzo(k)fluoranthene | 150 | N/A | UT |
| bis(2-ethylhexyl)phthalate | 210 | 10,200 | No |
| Butylbenzylphthalate | 220 | 29,800 | No |
| Chrysene | 820 | N/A | UT |
| Di-n-butylphthalate | 40 | 347,000 | No |
| Fluoranthene | 2,100 | N/A | UT |
| Fluorene | 160 | N/A | UT |
| Indeno(1,2,3-cd)pyrene | 140 | N/A | UT |
| **Total PCBs** | **3,900** | **1,350** | **Yes** |
| Phenanthrene | 1,300 | N/A | UT |
| Pyrene | 1,600 | N/A | UT |
| **Radionuclides (pCi/kg)** | | | |
| Americium-241 | 0.139 | 3,890 | No |
| Gross Alpha | 114 | N/A | UT |
| Gross Beta | 305 | N/A | UT |
| Plutonium-239/240 | 1,310 | 6,110 | No |
| Uranium-233/234 | 47.5 | 4,980 | No |
| Uranium-235 | 2.24 | 2,770 | No |
| Uranium-238 | 210 | 1,580 | No |

[a]The ESL for chromium (VI) was used.

[b]The ESLs for nitrate are used.

N/A = No ESL available.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

**Bold = Analyte retained for further consideration in the next ECOPC selection step.**

## Table 7.[illegible]

### Statistical Distributions and Comparison to Background for Surface Soil (Non-PMJM) in the UWOEU

| Analyte | Statistical Distribution Testing Results | | | | | | Background Comparison Test | | |
|---|---|---|---|---|---|---|---|---|---|
| | Background | | | UWOEU | | | | | |
| | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Test | 1 - p | Retain as ECOI? |
| **Inorganics** | | | | | | | | | |
| Aluminum | 20 | NORMAL | 100 | 130 | GAMMA | 100 | WRS | 0.364 | No |
| **Antimony** | **20** | **NON-PARAMETRIC** | **0** | **120** | **NON-PARAMETRIC** | **7** | **N/A** | **N/A** | **Yes[a]** |
| Arsenic | 20 | NORMAL | 100 | 130 | NORMAL | 100 | t-Test_N | 0.978 | No |
| **Barium** | **20** | **NORMAL** | **100** | **130** | **GAMMA** | **100** | **WRS** | **0.0330** | **Yes** |
| **Boron** | **N/A** | **N/A** | **N/A** | **18** | **NORMAL** | **72** | **N/A** | **N/A** | **Yes[a]** |
| Cadmium | 20 | NON-PARAMETRIC | 65 | 120 | NON-PARAMETRIC | 31 | WRS | 0.995 | No |
| Chromium | 20 | NORMAL | 100 | 130 | GAMMA | 99 | WRS | 0.187 | No |
| Cobalt | 20 | NORMAL | 100 | 130 | NORMAL | 88 | t-Test_N | 0.416 | No |
| **Copper** | **20** | **NON-PARAMETRIC** | **100** | **130** | **NON-PARAMETRIC** | **99** | **WRS** | **0.0120** | **Yes** |
| Lead | 20 | NORMAL | 100 | 135 | LOGNORMAL | 100 | WRS | 1 | No |
| Lithium | 20 | NORMAL | 100 | 128 | GAMMA | 92 | WRS | 0.541 | No |
| Manganese | 20 | NORMAL | 100 | 130 | GAMMA | 100 | WRS | 0.285 | No |
| Mercury | 20 | NON-PARAMETRIC | 40 | 128 | NON-PARAMETRIC | 47 | WRS | 0.898 | No |
| **Molybdenum** | **20** | **NORMAL** | **0** | **128** | **NON-PARAMETRIC** | **19** | **N/A** | **N/A** | **Yes[a]** |
| **Nickel** | **20** | **NORMAL** | **100** | **129** | **NON-PARAMETRIC** | **96** | **WRS** | **5.40E-04** | **Yes** |
| Selenium | 20 | NON-PARAMETRIC | 60 | 120 | NON-PARAMETRIC | 36 | WRS | 1 | No |
| **Silver** | **20** | **NORMAL** | **0** | **117** | **NON-PARAMETRIC** | **24** | **N/A** | **N/A** | **Yes[a]** |
| **Tin** | **20** | **NORMAL** | **0** | **129** | **NON-PARAMETRIC** | **12** | **N/A** | **N/A** | **Yes[a]** |
| **Uranium** | **N/A** | **N/A** | **N/A** | **18** | **NON-PARAMETRIC** | **39** | **N/A** | **N/A** | **Yes[a]** |
| **Vanadium** | **20** | **NORMAL** | **100** | **130** | **GAMMA** | **100** | **WRS** | **0.0960** | **Yes** |
| Zinc | 20 | NORMAL | 100 | 130 | NON-PARAMETRIC | 100 | WRS | 0.456 | No |

[a] Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation.

WRS = Wilcoxon Rank Sum

t-Test_N = Student's t-test using normal data

## Table 7.5

### Statistical Distributions and Comparison to Background for Surface Soil in PMJM Habitat in the UWOEU

| Analyte | Units | Statistical Distribution Testing Results | | | | | | Background | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Background | | | UWOEU | | | | | |
| | | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Test | 1 - p | Retain as ECOI? |
| **Inorganics** | | | | | | | | | | |
| **Antimony** | mg/kg | 20 | NONPARAMETRIC | 0 | 29 | NONPARAMETRIC | 13.8 | N/A | N/A | **Yes**[a] |
| Arsenic | mg/kg | 20 | NORMAL | 100 | 34 | NORMAL | 100 | t-Test N | 0.951 | No |
| Cadmium | mg/kg | 20 | NONPARAMETRIC | 65 | 32 | NONPARAMETRIC | 34.4 | WRS | 0.856 | No |
| **Chromium** | mg/kg | 20 | NORMAL | 100 | 34 | NORMAL | 100 | t-Test N | 0.00300 | **Yes** |
| **Copper** | mg/kg | 20 | NONPARAMETRIC | 100 | 34 | NONPARAMETRIC | 100 | WRS | 0.00200 | **Yes** |
| **Manganese** | mg/kg | 20 | NORMAL | 100 | 34 | GAMMA | 100 | WRS | 0.0170 | **Yes** |
| Mercury | mg/kg | 20 | NONPARAMETRIC | 40 | 33 | NONPARAMETRIC | 57.6 | WRS | 0.609 | No |
| **Molybdenum** | mg/kg | 20 | NORMAL | 0 | 33 | LOGNORMAL | 18.2 | N/A | N/A | **Yes**[a] |
| **Nickel** | mg/kg | 20 | NORMAL | 100 | 33 | NORMAL | 90.9 | t-Test N | 9.00E-04 | **Yes** |
| Selenium | mg/kg | 20 | NONPARAMETRIC | 60 | 33 | NONPARAMETRIC | 39.4 | WRS | 1 | No |
| **Tin** | mg/kg | 20 | NORMAL | 0 | 34 | LOGNORMAL | 17.7 | N/A | N/A | **Yes**[a] |
| **Vanadium** | mg/kg | 20 | NORMAL | 100 | 34 | NONPARAMETRIC | 100 | t-Test N | 0.0170 | **Yes** |
| **Zinc** | mg/kg | 20 | NORMAL | 100 | 34 | LOGNORMAL | 100 | WRS | 0.0100 | **Yes** |

[a] Statistical comparisons to background cannot be performed. The analyte is retained for further evaluation.

WRS = Wilcoxon Rank Sum

t-Test_N = Student's t-test using normal data

N/A = Not applicable; site and/or background detection frequency less than 20%.

**Bold = Analyte retained for further consideration in the next ECOPC selection step.**

Table 7.6

Statistical Concentrations in Surface Soil (Non-PMJM) in the UWOEU

| Analyte | Total Samples | UCL Recommended by ProUCL | Distribution Recommended by ProUCL | Mean | Median | 75th Percentile | 95th Percentile | 95UCL | 95UTL | MDC |
|---|---|---|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)** | | | | | | | | | | |
| Antimony | 120 | 97.5% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 4.53 | 2.90 | 6.35 | 7.40 | 7.86 | 7.35 | 49.8 |
| Barium | 130 | 95% Approximate Gamma UCL | GAMMA | 122 | 120 | 142 | 205 | 129 | 199 | 464 |
| Boron | 18 | 95% Student's-t UCL | NORMAL | 5.21 | 5.65 | 6.48 | 8.88 | 6.36 | 10.7 | 11 |
| Copper | 130 | 95% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 24.6 | 15.2 | 20.3 | 75.4 | 38.5 | 68.3 | 330 |
| Molybdenum | 128 | 95% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 1.14 | 0.800 | 1.40 | 2.22 | 1.50 | 2.15 | 5.90 |
| Nickel | 129 | 95% Student's-t UCL | NON-PARAMETRIC | 13.2 | 12.7 | 15.6 | 21.2 | 14 | 21.1 | 48 |
| Silver | 117 | 97.5% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 2.47 | 0.425 | 0.650 | 3.60 | 9.69 | 3.30 | 98 |
| Tin | 129 | 97.5% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 6.28 | 2.80 | 5.30 | 38.3 | 12.7 | 21.1 | 66.9 |
| Uranium | 18 | 99% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 8.60 | 0.800 | 7.25 | 34.8 | 55.8 | 85 | 85 |
| Vanadium | 130 | 95% Approximate Gamma UCL | GAMMA | 30.7 | 29.9 | 35.5 | 47.7 | 32.1 | 47 | 54.8 |
| **Organics (µg/kg)** | | | | | | | | | | |
| 2-Methylnaphthalene | 88 | 95% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 406 | 205 | 380 | 451 | 989 | 460 | 12,000 |
| Acenapthene | 101 | 95% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 765 | 220 | 405 | 700 | 2,653 | 700 | 44,000 |
| Benzo(a)pyrene | 98 | 95% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 810 | 235 | 400 | 1,200 | 2,719 | 1,200 | 43,000 |
| bis(2-ethylhexyl)phthalate | 89 | 95% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 273 | 200 | 370 | 425 | 443 | 410 | 3,500 |
| Di-n-butylphthalate | 89 | 95% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 250 | 200 | 375 | 410 | 302 | 410 | 480 |
| Dioxin - TEQ (mammals) | 10 | 95% Adjusted Gamma UCL | GAMMA | 0.0110 | 0.00300 | 0.00500 | 0.0460 | 0.0550 | 0.0739 | 0.0739 |
| Dioxin - TEQ (birds) | 10 | 95% Adjusted Gamma UCL | GAMMA | 0.0180 | 0.00500 | 0.00900 | 0.0780 | 0.0960 | 0.126 | 0.126 |
| Fluorene | 106 | 95% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 614 | 200 | 370 | 454 | 2,211 | 435 | 39,000 |
| Naphthalene | 113 | 97.5% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 696 | 220 | 405 | 720 | 2,951 | 700 | 41,000 |
| PCBs - Total | 90 | 97.5% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 331 | 173 | 199 | 1,465 | 727 | 1,300 | 3,900 |

MDC = Maximum detected concentration or in some cases, maximum proxy result.

UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then MDC is used as the UCL.

UTL = 95% upper confidence limit on the 90th percentile value, unless the MDC< UTL than the MDC is used as the UTL.

## Table 7.7
## Upper-Bound Exposure Point Concentration Comparison to Limiting tESLs for Surface Soil (Non-PMJM) in the UWOEU

| Analyte | Small Home Range Receptors | | | Large Home Range Receptors | | |
|---|---|---|---|---|---|---|
| | EPC (95UTL) | Limiting ESL[1] | EPC>ESL? | EPC (95UCL) | Limiting ESL[2] | EPC>ESL? |
| Inorganics (mg/kg) | | | | | | |
| **Antimony** | 7.35 | 0.900 | Yes | 7.86 | 3.85 | Yes |
| Barium | 199 | 222 | No | 129 | 4,766 | No |
| **Boron** | 10.7 | 0.500 | Yes | 6.36 | 314 | No |
| **Copper** | 68.3 | 8.25 | Yes | 38.5 | 3,000 | No |
| **Molybdenum** | 2.15 | 1.90 | Yes | 1.50 | 8.18 | No |
| **Nickel** | 21.1 | 0.430 | Yes | 14 | 1.86 | Yes |
| **Silver** | 3.30 | 2 | Yes | 9.69 | N/A | N/A |
| **Tin** | 21.1 | 2.90 | Yes | 12.7 | 16 | No |
| **Uranium** | 85 | 5 | Yes | 55.8 | 2,270 | No |
| **Vanadium** | 47 | 2 | Yes | 32.1 | 121 | No |
| Organics (µg/kg) | | | | | | |
| 2-methylnaphthalene | 460 | 4,030 | No | 989 | 12,000 | No |
| Acenaphthene | 700 | 20,000 | No | 2,653 | N/A | N/A |
| Benzo(a)pyrene | 1,200 | 3,160 | No | 2,719 | 2,760 | No |
| **bis(2-ethylhexyl)phthalate** | 410 | 137 | Yes | 443 | 35,000 | No |
| **Di-n-butylphthalate** | 410 | 15.9 | Yes | 302 | 1.22E+06 | No |
| **Dioxin - TEQ (mammals)** | 0.0739 | 0.00425 | Yes | 0.0550 | 0.0146 | Yes |
| **Dioxin - TEQ (birds)** | 0.126 | 0.0134 | Yes | 0.0960 | N/A | N/A |
| Fluorene | 435 | 30,000 | No | 2,211 | N/A | N/A |
| Napthalene | 700 | 27,100 | No | 2,951 | 104,000 | No |
| **Total PCBs** | 1,300 | 42.3 | Yes | 727 | 3,320 | No |

[1]Threshold ESL (if available)

[2]Lowest ESL (threshold if available) for the coyote and mule deer receptors.

N/A = not applicable, ESL not available.

**Bold = Analyte retained for further consideration in the next ECOPC selection step.**

Table 7.8

**Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Small Home-Range Receptors in the UWOEU Surface Soil (Non-PMJM)**

| Analyte | Small Home Range Receptor UTL | Receptor-Specific ESLs[a] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Terrestrial Plant | Terrestrial Invertebrate | American Kestrel | Mourning Dove (herbivore) | Mourning Dove (insectivore) | Deer Mouse (herbivore) | Deer Mouse (insectivore) | Prairie Dog |
| **Inorganics (mg/kg)** | | | | | | | | | |
| Antimony | 7.35 | **5** | 78 | N/A | N/A | N/A | 9.89 | **0.905** | 18.7 |
| Boron | 10.7 | **0.500** | N/A | 167 | 30.3 | 115 | 62.1 | 422 | 237 |
| Copper | 68.3 | 100 | 50 | 164 | **28.9** | **8.25** | 295 | 605 | 838 |
| Molybdenum | 2.15 | **2** | N/A | 76.7 | 44.4 | 6.97 | 8.68 | **1.90** | 27.1 |
| Nickel | 21.1 | 30 | 200 | 89.9 | 320 | **7.84** | **16.4** | **0.430** | 38.3 |
| Silver | 3.30 | **2** | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Tin | 21.1 | 50 | N/A | **19** | 26.1 | **2.90** | 45 | **3.77** | 80.6 |
| Uranium | 85 | **5** | N/A | 2,790 | 685 | 446 | 970 | 569 | 1,230 |
| Vanadium | 47 | **2** | N/A | 1,150 | 503 | 274 | 63.7 | **29.9** | 83.5 |
| **Organics (µg/kg)** | | | | | | | | | |
| bis(2-ethylhexyl)phthalate | 410 | N/A | N/A | **398** | 19,500 | **137** | 960,000 | 8,070 | 2.76E+06 |
| Di-n-butylphthalate | 410 | 200,000 | N/A | **41.5** | 989 | **15.9** | 1.21E+07 | 281,000 | 4.06E+07 |
| 2,3,7,8-TCDD TEQ (mammals) | 0.0739 | N/A | N/A | N/A | N/A | N/A | **0.0375** | **0.00425** | 0.116 |
| Dioxin - TEQ (birds) | 0.126 | N/A | N/A | **0.0775** | 0.194 | **0.0134** | N/A | N/A | N/A |
| PCBs - Total | 1,300 | 40,000 | N/A | **42.3** | **1,140** | **172** | 17,000 | 1,610 | 53,200 |

[a]Threshold ESL (if available)

N/A = Not applicable; ESL not available.

**Bold = Receptors of potential concern.**

**Table 7.9**

**Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Large Home-Range Receptors in the UWOEU Surface Soil (Non-PMJM)**

| Analyte | Large Home-Range Receptor UCL | Receptor-Specific ESLs[a] | | | |
|---|---|---|---|---|---|
| | | Mule Deer | Coyote (carnivore) | Coyote (generalist) | Coyote (insectivore) |
| **Inorganics (mg/kg)** | | | | | |
| Antimony | 7.86 | 57.6 | 138 | 13.2 | **3.85** |
| Nickel | 14 | 124 | 90.9 | **6.02** | **1.86** |
| **Organics (µg/kg)** | | | | | |
| Dioxin - TEQ (mammal) | 0.0550 | 0.192 | 0.0735 | **0.0339** | **0.0146** |

[a]Threshold ESL (if available)

**Bold = Receptors of potential concern.**

**Table 7.10**
**Summary of ECOPC Screening Steps for Surface Soil Non-PMJM Receptors in the UWOEU**

| Analyte | Exceeds Any NOAEL ESL? | Detection Frequency >5%? | Exceeds Background? | Upper Bound EPC > Limiting ESL | Professional Judgment Retain? | ECOPC? | Receptor(s) of Potential Concern |
|---|---|---|---|---|---|---|---|
| **Inorganics** | | | | | | | |
| Aluminum | Yes | Yes | No | -- | -- | No | -- |
| Ammonia | No | -- | -- | -- | -- | No | -- |
| **Antimony** | Yes | Yes | N/A | Yes | Yes | Yes | **Terrestrial Plant<br>Deer Mouse (insectivore)<br>Coyote (insectivore)** |
| Arsenic | Yes | Yes | No | -- | -- | No | -- |
| Barium | Yes | Yes | Yes | No | -- | No | -- |
| Beryllium | No | -- | -- | -- | -- | No | -- |
| Boron | Yes | Yes | N/A | Yes | No | No | -- |
| Cadmium | Yes | Yes | No | -- | -- | No | -- |
| Calcium | N/A | -- | -- | -- | -- | No | -- |
| Cesium | N/A | -- | -- | -- | -- | No | -- |
| Chromium | Yes | Yes | No | -- | -- | No | -- |
| Cobalt | Yes | Yes | No | -- | -- | No | -- |
| **Copper** | Yes | Yes | Yes | Yes | Yes | Yes | **Mourning dove (herbivore)<br>Mourning dove (insectivore)** |
| Iron | N/A | -- | -- | -- | -- | No | -- |
| Lead | Yes | Yes | No | -- | -- | No | -- |
| Lithium | Yes | Yes | No | -- | -- | No | -- |
| Magnesium | N/A | -- | -- | -- | -- | No | -- |
| Manganese | Yes | Yes | No | -- | -- | No | -- |
| Mercury | Yes | Yes | No | -- | -- | No | -- |
| Molybdenum | Yes | Yes | N/A | Yes | No | No | -- |
| **Nickel** | Yes | Yes | Yes | Yes | Yes | Yes | **Mourning dove (insectivore)<br>Deer mouse (herbivore)<br>Deer mouse (insectivore)<br>Coyote (generalist)<br>Coyote (insectivore)** |
| Nitrate / Nitrite | No | -- | -- | -- | -- | No | -- |
| Potassium | N/A | -- | -- | -- | -- | No | -- |
| Selenium | Yes | Yes | No | -- | -- | No | -- |
| Silica | N/A | -- | -- | -- | -- | No | -- |
| Silicon | N/A | -- | -- | -- | -- | No | -- |
| **Silver** | Yes | Yes | N/A | Yes | Yes | Yes | **Terrestrial plant** |
| Sodium | N/A | -- | -- | -- | -- | No | -- |
| Strontium | No | -- | -- | -- | -- | No | -- |
| Thallium | No | -- | -- | -- | -- | No | -- |
| **Tin** | Yes | Yes | N/A | Yes | Yes | Yes | **American kestrel<br>Mourning dove (insectivore)<br>Deer mouse (insectivore)** |
| Titanium | N/A | -- | -- | -- | -- | No | -- |
| **Uranium** | Yes | Yes | N/A | Yes | Yes | Yes | **Terrestrial plant** |
| Vanadium | Yes | Yes | Yes | Yes | No | No | -- |
| Zinc | Yes | Yes | No | -- | -- | No | -- |
| **Organics** | | | | | | | |
| 1,2,4-Trichlorobenzene | No | -- | -- | -- | -- | No | -- |
| 1,2,4-Trimethylbenzene | N/A | -- | -- | -- | -- | No | -- |
| 2-Butanone | N/A | -- | -- | -- | -- | No | -- |
| 2-Methylnaphthalene | Yes | Yes | N/A | No | -- | No | -- |
| 4,4'-DDT | Yes | No | -- | -- | -- | No | -- |
| 4-Methyl-2-pentanone | No | -- | -- | -- | -- | No | -- |
| Acenaphthene | Yes | Yes | N/A | No | -- | No | -- |
| Acetone | No | -- | -- | -- | -- | No | -- |
| Aldrin | No | -- | -- | -- | -- | No | -- |
| Anthracene | N/A | -- | -- | -- | -- | No | -- |
| Benzene | No | -- | -- | -- | -- | No | -- |
| Benzo(a)anthracene | N/A | -- | -- | -- | -- | No | -- |
| Benzo(a)pyrene | Yes | Yes | N/A | No | -- | No | -- |
| Benzo(b)fluoranthene | N/A | -- | -- | -- | -- | No | -- |
| Benzo(g,h,i)perylene | N/A | -- | -- | -- | -- | No | -- |
| Benzo(k)fluoranthene | N/A | -- | -- | -- | -- | No | -- |

**Table 7.10**
**Summary of ECOPC Screening Steps for Surface Soil Non-PMJM Receptors in the UWOEU**

| Analyte | Exceeds Any NOAEL ESL? | Detection Frequency >5%? | Exceeds Background?[a] | Upper Bound EPC > Limiting ESL | Professional Judgment Retain? | ECOPC? | Receptor(s) of Potential Concern |
|---|---|---|---|---|---|---|---|
| Benzoic Acid | N/A | -- | -- | -- | -- | No | -- |
| Benzyl Alcohol | No | -- | -- | -- | -- | No | -- |
| **bis(2-ethylhexyl)phthalate** | **Yes** | **Yes** | **N/A** | **Yes** | **Yes** | **Yes** | **American kestrel**<br>**Mourning dove (insectivore)** |
| Butylbenzylphthalate | No | -- | -- | -- | -- | No | -- |
| Carbazole | N/A | -- | -- | -- | -- | No | -- |
| Chrysene | N/A | -- | -- | -- | -- | No | -- |
| **Di-n-butylphthalate** | **Yes** | **Yes** | **N/A** | **Yes** | **Yes** | **Yes** | **American kestrel**<br>**Mourning dove (insectivore)** |
| Di-n-octylphthalate | No | -- | -- | -- | -- | No | -- |
| Dibenz(a,h)anthracene | N/A | -- | -- | -- | -- | No | -- |
| Dibenzofuran | No | -- | -- | -- | -- | No | -- |
| Dieldrin | Yes | No | -- | -- | -- | No | -- |
| **Dioxin TEQ (mammals)** | **Yes** | **Yes** | **N/A** | **Yes** | **Yes** | **Yes** | **Deer mouse (herbivore)**<br>**Deer mouse (insectivore)**<br>**Coyote (insectivore)**<br>**Coyote (generalist)** |
| **Dioxin TEQ (birds)** | **Yes** | **Yes** | **N/A** | **Yes** | **Yes** | **Yes** | **American kestrel**<br>**Mourning dove (insectivore)** |
| Endosulfan sulfate | No | -- | -- | -- | -- | No | -- |
| Endrin ketone | Yes | No | -- | -- | -- | No | -- |
| Fluoranthene | N/A | -- | -- | -- | -- | No | -- |
| Fluorene | Yes | Yes | N/A | No | -- | No | -- |
| Heptachlor epoxide | No | -- | -- | -- | -- | No | -- |
| Indeno(1,2,3-cd)pyrene | N/A | -- | -- | -- | -- | No | -- |
| Isophorone | N/A | -- | -- | -- | -- | No | -- |
| Methoxychlor | No | -- | -- | -- | -- | No | -- |
| Methylene Chloride | No | -- | -- | -- | -- | No | -- |
| Naphthalene | Yes | Yes | N/A | No | -- | No | -- |
| **PCBs - Total** | **Yes** | **Yes** | **N/A** | **Yes** | **Yes** | **Yes** | **American kestrel**<br>**Mourning dove (herbivore)**<br>**Mourning dove (insectivore)** |
| Phenanthrene | N/A | -- | -- | -- | -- | No | -- |
| Phenol | No | -- | -- | -- | -- | No | -- |
| Pyrene | N/A | -- | -- | -- | -- | No | -- |
| Tetrachloroethene | N/A | -- | -- | -- | -- | No | -- |
| Toluene | No | -- | -- | -- | -- | No | -- |
| Xylene | No | -- | -- | -- | -- | No | -- |
| **Radionuclides** | | | | | | | |
| Americium-241 | No | -- | -- | -- | -- | No | -- |
| Cesium-137 | No | -- | -- | -- | -- | No | -- |
| Gross Alpha | N/A | -- | -- | -- | -- | No | -- |
| Gross Beta | N/A | -- | -- | -- | -- | No | -- |
| Neptunium-237 | N/A | -- | -- | -- | -- | No | -- |
| Plutonium-238 | N/A | -- | -- | -- | -- | No | -- |
| Plutonium-239/240 | No | -- | -- | -- | -- | No | -- |
| Radium-226 | No | -- | -- | -- | -- | No | -- |
| Radium-228 | No | -- | -- | -- | -- | No | -- |
| Uranium-233/234 | No | -- | -- | -- | -- | No | -- |
| Uranium-235 | No | -- | -- | -- | -- | No | -- |
| Uranium-238 | No | -- | -- | -- | -- | No | -- |

[a] Based on results of statistical analysis at the 0.1 level of significance.
-- - Screen not performed because ECOI was eliminated from further consideration in a previous step.
N/A - Not applicable; ESL not available or background comparison could not be conducted.
**Bold = Analyte retained for further consideration in the next ECOPC selection step.**

**Table 7.11**

**Summary of ECOPC Screening Steps for Surface Soil PMJM Receptors in the UWOEU**

| Analyte | Exceed PMJM NOAEL ESL? | Exceeds Background? | Professional Judgment - Retain? | ECOPC? |
|---|---|---|---|---|
| **Inorganics** | | | | |
| Aluminum | UT | -- | -- | No |
| Ammonia | No | -- | -- | No |
| **Antimony** | **Yes** | **N/A** | **Yes** | **Yes** |
| Arsenic | Yes | No | -- | No |
| Barium | No | -- | -- | No |
| Beryllium | No | -- | -- | No |
| Boron | No | -- | -- | No |
| Cadmium | Yes | No | -- | No |
| Calcium | UT | -- | -- | No |
| Cesium | UT | -- | -- | No |
| **Chromium** | **Yes** | **Yes** | **Yes** | **Yes** |
| Cobalt | No | -- | -- | No |
| **Copper** | **Yes** | **Yes** | **Yes** | **Yes** |
| Iron | UT | -- | -- | No |
| Lead | No | -- | -- | No |
| Lithium | No | -- | -- | No |
| Magnesium | UT | -- | -- | No |
| **Manganese** | **Yes** | **Yes** | **Yes** | **Yes** |
| Mercury | Yes | No | -- | No |
| **Molybdenum** | **Yes** | **N/A** | **Yes** | **Yes** |
| **Nickel** | **Yes** | **Yes** | **Yes** | **Yes** |
| Nitrate / Nitrite | No | -- | -- | No |
| Potassium | UT | -- | -- | No |
| Selenium | Yes | No | -- | No |
| Silica | UT | -- | -- | No |
| Silicon | UT | -- | -- | No |
| Silver | UT | -- | -- | No |
| Sodium | UT | -- | -- | No |
| Strontium | No | -- | -- | No |
| Thallium | No | -- | -- | No |
| **Tin** | **Yes** | **N/A** | **Yes** | **Yes** |
| Titanium | UT | -- | -- | No |
| Uranium | No | -- | -- | No |
| **Vanadium** | **Yes** | **Yes** | **Yes** | **Yes** |
| **Zinc** | **Yes** | **Yes** | **Yes** | **Yes** |
| **Organics** | | | | |
| Acenaphthene | UT | -- | -- | No |
| Anthracene | UT | -- | -- | No |
| Benzo(a)anthracene | UT | -- | -- | No |
| Benzo(a)pyrene | No | -- | -- | No |
| Benzo(b)fluoranthene | UT | -- | -- | No |
| Benzo(g,h,i)perylene | UT | -- | -- | No |
| Benzo(k)fluoranthene | UT | -- | -- | No |
| bis(2-ethylhexyl)phthalate | No | -- | -- | No |
| Butylbenzylphthalate | No | -- | -- | No |
| Chrysene | UT | -- | -- | No |
| Di-n-butylphthalate | No | -- | -- | No |
| Fluoranthene | UT | -- | -- | No |
| Fluorene | UT | -- | -- | No |
| Indeno(1,2,3-cd)pyrene | UT | -- | -- | No |
| **PCBs - Total** | **Yes** | **N/A** | **Yes** | **Yes** |
| Phenanthrene | UT | -- | -- | No |
| Pyrene | UT | -- | -- | No |
| **Radionuclides** | | | | |
| Americium-241 | No | -- | -- | No |
| Gross Alpha | UT | -- | -- | No |
| Gross Beta | UT | -- | -- | No |
| Plutonium-239/240 | No | -- | -- | No |
| Uranium-233/234 | No | -- | -- | No |
| Uranium-235 | No | -- | -- | No |
| Uranium-238 | No | -- | -- | No |

-- = Screen not performed because ECOI did not pass the previous screen.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

**Bold = Analyte retained as an ECOPC for risk characterization.**

N/A - Not applicable; ESL not available or background comparison could not be conducted.

**Table 7.12**
**Comparison of MDCs in Subsurface Soil to NOAEL ESLs for Burrowing Receptors in the UWOEU**

| Analyte | MDC | Prairie Dog NOAEL ESL | MDC > ESL? |
|---|---|---|---|
| **Inorganics (mg/kg)** | | | |
| Aluminum | 32,800 | N/A | UT |
| **Antimony** | **149** | **18.7** | **Yes** |
| **Arsenic** | **24.3** | **9.35** | **Yes** |
| Barium | 1,610 | 3,224 | No |
| **Beryllium** | **446** | **211** | **Yes** |
| Boron | 4.70 | 237 | No |
| Cadmium | 71 | 198 | No |
| Calcium | 60,000 | N/A | UT |
| Cesium | 29.6 | N/A | UT |
| **Chromium** | **8,310** | **703** | **Yes** |
| Cobalt | 701 | 2,461 | No |
| **Copper** | **8,850** | **838** | **Yes** |
| Iron | 107,000 | N/A | UT |
| **Lead** | **5,200** | **1,850** | **Yes** |
| Lithium | 29 | 3,178 | No |
| Magnesium | 9,480 | N/A | UT |
| **Manganese** | **2,150** | **1,519** | **Yes** |
| Mercury | 1.40 | 3.15 | No |
| **Molybdenum** | **470** | **27.1** | **Yes** |
| **Nickel** | **4,750** | **38.3** | **Yes** |
| Phosphorus | 975 | N/A | UT |
| Potassium | 4,190 | N/A | UT |
| **Selenium** | **80.8** | **2.80** | **Yes** |
| Silica | 850 | N/A | UT |
| Silicon | 1,120 | N/A | UT |
| Silver | 311 | N/A | UT |
| Sodium | 3,360 | N/A | UT |
| Strontium | 170 | 3,519 | No |
| Thallium | 6.30 | 204 | No |
| **Tin** | **579** | **80.6** | **Yes** |
| Titanium | 283 | N/A | UT |
| Uranium | 5.50 | 1,226 | No |
| Vanadium | 74.4 | 83.5 | No |
| **Zinc** | **6,920** | **1,174** | **Yes** |
| **Organics (µg/kg)** | | | |
| 1,1,1-Trichloroethane | 2 | 4.85E+07 | No |
| 1,2,4-Trimethylbenzene | 60 | N/A | UT |
| 1,2-Dichlorobenzene | 30 | N/A | UT |
| 1,3-Dichlorobenzene | 20 | N/A | UT |
| 1,4-Dichlorobenzene | 10 | N/A | UT |
| 2-Butanone | 8 | N/A | UT |
| 2-Chlorophenol | 10 | 21,600 | No |
| 2-Methylnaphthalene | 15,000 | 319,000 | No |
| 3,3'-Dichlorobenzidine | 160 | N/A | UT |
| 4-Chloro-3-methylphenol | 10 | N/A | UT |
| 4-Methyl-2-pentanone | 2 | 859,000 | No |
| Acenaphthene | 31,000 | N/A | UT |
| Acenaphthalene | 47 | N/A | UT |
| Acetone | 330 | 248,000 | No |
| alpha-BHC | 15 | 2.47E+06 | No |
| Anthracene | 46,000 | N/A | UT |
| Benzo(a)anthracene | 48,000 | N/A | UT |
| Benzo(a)pyrene | 43,000 | 503,000 | No |
| Benzo(b)fluoranthene | 48,000 | N/A | UT |
| Benzo(g,h,i)perylene | 19,000 | N/A | UT |
| Benzo(k)fluoranthene | 19,000 | N/A | UT |
| Benzoic Acid | 260 | N/A | UT |
| bis(2-ethylhexyl)phthalate | 540 | 2.76E+06 | No |
| Bromoform | 2 | 199,000 | No |
| Butylbenzylphthalate | 1,400 | 3.37E+06 | No |
| Chrysene | 53,000 | N/A | UT |
| cis-1,2-Dichloroethene | 10.1 | 133,000 | No |
| Di-n-butylphthalate | 2,700 | 4.06E+07 | No |
| Di-n-octylphthalate | 50 | 2.58E+08 | No |
| Dibenz(a,h)anthracene | 890 | N/A | UT |

## Table 7.12
## Comparison of MDCs in Subsurface Soil to NOAEL ESLs for Burrowing Receptors in the UWOEU

| Analyte | MDC | Prairie Dog NOAEL ESL | MDC > ESL? |
|---|---|---|---|
| Dibenzofuran | 20,000 | 2.44E+06 | No |
| Diethylphthalate | 250 | 2.21E+08 | No |
| Dioxin TEQ - mammals | 0.00200 | 0.116 | No |
| Fluoranthene | 160,000 | N/A | UT |
| Fluorene | 35,000 | N/A | UT |
| Heptachlor epoxide | 11 | 9,120 | No |
| Hexachlorobenzene | 30 | 190,000 | No |
| Indeno(1,2,3-cd)pyrene | 22,000 | N/A | UT |
| Isophorone | 82 | N/A | UT |
| Methylene Chloride | 67 | 210,000 | No |
| Naphthalene | 61,000 | 1.60E+07 | No |
| PCBs - Total | 1,300 | 38,000 | No |
| Pentachlorophenol | 160 | 18,400 | No |
| Phenanthrene | 220,000 | N/A | UT |
| Phenol | 140 | 1.49E+06 | No |
| Pyrene | 150,000 | N/A | UT |
| Tetrachloroethane | 920 | 72,500 | No |
| Toluene | 420 | 1.22E+06 | No |
| Trichloroethene | 440 | 32,400 | No |
| **Radionuclides (pCi/g)** | | | |
| Americium-241 | 2.97 | 3,890 | No |
| Cesium-137 | 0.0720 | 20.8 | No |
| Gross Alpha | 742 | N/A | UT |
| Gross Beta | 1,580 | N/A | UT |
| Plutonium-238 | 9.84 | N/A | UT |
| Plutonium-239/240 | 5.16 | 6,110 | No |
| Radium-226 | 2.09 | 50.6 | No |
| Radium-228 | 2.79 | 43.9 | No |
| Strontium-89/90 | 0.969 | 22.5 | No |
| Uranium-233/234 | 288 | 4,980 | No |
| Uranium-235 | 37.7 | 2,770 | No |
| Uranium-238 | 1,160 | 1,580 | No |

N/A = Indicates no ESL was available for that ECOI/receptor pair.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

**Bold = Analyte retained for further consideration in the next ECOPC selection step.**

**Table 7.13**
**Statistical Distributions and Comparison to Background for Subsurface Soil in the UWOEU**

| Analyte | Statistical Distribution Testing Results | | | | | | Background Comparison Test | | |
|---|---|---|---|---|---|---|---|---|---|
| | Background | | | UWOEU[a] | | | | | |
| | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Test | 1 - p | Retain as ECOI? |
| **Antimony** | 28 | NONPARAMETRIC | 7 | 229 | NONPARAMETRIC | 21 | N/A | N/A | **Yes[a]** |
| Arsenic | 45 | NONPARAMETRIC | 93 | 252 | NONPARAMETRIC | 100 | WRS | 0.760 | No |
| Beryllium | 45 | GAMMA | 96 | 257 | NONPARAMETRIC | 76 | WRS | 1 | No |
| Chromium | 45 | GAMMA | 100 | 252 | NONPARAMETRIC | 100 | WRS | 0.794 | No |
| **Copper** | 45 | NORMAL | 96 | 252 | NONPARAMETRIC | 97 | WRS | 4.49E-07 | **Yes** |
| Lead | 45 | GAMMA | 100 | 257 | NONPARAMETRIC | 100 | WRS | 0.102 | No |
| **Manganese** | 45 | GAMMA | 100 | 252 | GAMMA | 100 | WRS | 6.70E-05 | **Yes** |
| Molybdenum | 45 | NONPARAMETRIC | 67 | 251 | NONPARAMETRIC | 24 | WRS | 1 | No |
| Nickel | 44 | GAMMA | 100 | 252 | NONPARAMETRIC | 96 | WRS | 0.979 | No |
| **Selenium** | 38 | LOGNORMAL | 0 | 247 | NONPARAMETRIC | 14 | N/A | N/A | **Yes[a]** |
| **Tin** | 41 | NONPARAMETRIC | 37 | 251 | NONPARAMETRIC | 9 | N/A | N/A | **Yes[a]** |
| **Zinc** | 44 | NORMAL | 100 | 252 | NONPARAMETRIC | 100 | WRS | 4.86E-04 | **Yes** |

a Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation.

N/A = Not applicable; background data not available or not detected.

**Bold = Analyte retained for further consideration in the next ECOPC selection step.**

Table 7.14

Statistical Concentrations in Subsurface Soil in the UWOEU

| Analyte | Total Samples | UCL Recommended by ProUCL | Distribution Recommended by ProUCL | Mean | Median | 75th Percentile | 95th Percentile | 95UCL | 95UTL | MDC |
|---|---|---|---|---|---|---|---|---|---|---|
| Inorganics (mg/kg) | | | | | | | | | | |
| Antimony | 229 | 97.5% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 7 | 5.10 | 7.10 | 18.1 | 11.9 | 15.8 | 149 |
| Copper | 252 | 97.5% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 140 | 16.9 | 22.2 | 376 | 440 | 92 | 8,850 |
| Manganese | 252 | 95% Approximate Gamma UCL | GAMMA | 279 | 220 | 344 | 782 | 302 | 617 | 2,150 |
| Selenium | 247 | 95% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 0.569 | 0.120 | 0.270 | 0.486 | 2 | 0.460 | 80.8 |
| Tin | 251 | 95% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 8.73 | 3.85 | 4.55 | 22.5 | 19.4 | 12.3 | 579 |
| Zinc | 252 | 97.5% Chebyshev (Mean, Sd) UCL | NON-PARAMETRIC | 137 | 48.5 | 61.2 | 510 | 337 | 213 | 6,920 |

MDC = maximum detected concentration.

UCL = 95% upper confidence limit on the mean

UTL = 95% upper confidence limit on the 90th percentile value

**Table 7.15**
**Upper-Bound Exposure Point Concentration Comparison to tESLs in the UWOEU**

| Analyte | Burrowing Receptor | | |
|---|---|---|---|
| | EPC (UTL) | tESL[a] | EPC>ESL? |
| **Inorganics (mg/kg)** | | | |
| Antimony | 15.8 | 18.7 | No |
| Copper | 92 | 838 | No |
| Manganese | 617 | 1,519 | No |
| Selenium | 0.460 | 2.80 | No |
| Tin | 12.3 | 80.6 | No |
| Zinc | 213 | 1,170 | No |

[a] Threshold ESL (if available) for the prairie dog receptor.

**Table 7.16**
**Summary of ECOPC Screening Steps for Subsurface Soil in the UWOEU**

| Analyte | Exceed Any NOAEL ESL? | Frequency of Detection >5%? | Exceeds Background?[a] | Upper Bound EPC > Limiting ESL? | Professional Judgment - Retain? | Retain as ECOPC? |
|---|---|---|---|---|---|---|
| **Inorganics** | | | | | | |
| Aluminum | N/A | -- | -- | -- | -- | No |
| Antimony | Yes | Yes | N/A | No | -- | No |
| Arsenic | Yes | Yes | No | -- | -- | No |
| Barium | No | -- | -- | -- | -- | No |
| Beryllium | Yes | Yes | No | -- | -- | No |
| Boron | No | -- | -- | -- | -- | No |
| Cadmium | No | -- | -- | -- | -- | No |
| Calcium | N/A | -- | -- | -- | -- | No |
| Cesium | N/A | -- | -- | -- | -- | No |
| Chromium | Yes | Yes | No | -- | -- | No |
| Cobalt | No | -- | -- | -- | -- | No |
| Copper | Yes | Yes | Yes | No | -- | No |
| Iron | N/A | -- | -- | -- | -- | No |
| Lead | Yes | Yes | No | -- | -- | No |
| Lithium | No | -- | -- | -- | -- | No |
| Magnesium | N/A | -- | -- | -- | -- | No |
| Manganese | Yes | Yes | Yes | No | -- | No |
| Mercury | No | -- | -- | -- | -- | No |
| Molybdenum | Yes | Yes | No | -- | -- | No |
| Nickel | Yes | Yes | No | -- | -- | No |
| Phosphorus | N/A | -- | -- | -- | -- | No |
| Potassium | N/A | -- | -- | -- | -- | No |
| Selenium | Yes | Yes | N/A | No | -- | No |
| Silica | N/A | -- | -- | -- | -- | No |
| Silicon | N/A | -- | -- | -- | -- | No |
| Silver | N/A | -- | -- | -- | -- | No |
| Sodium | N/A | -- | -- | -- | -- | No |
| Strontium | No | -- | -- | -- | -- | No |
| Thallium | No | -- | -- | -- | -- | No |
| Tin | Yes | Yes | N/A | No | -- | No |
| Titanium | N/A | -- | -- | -- | -- | No |
| Uranium | No | -- | -- | -- | -- | No |
| Vanadium | No | -- | -- | -- | -- | No |
| Zinc | Yes | Yes | Yes | No | -- | No |
| **Organics** | | | | | | |
| 1,1,1-Trichloroethane | No | -- | -- | -- | -- | No |
| 1,2,4-Trimethylbenzene | N/A | -- | -- | -- | -- | No |
| 1,2-Dichlorobenzene | N/A | -- | -- | -- | -- | No |
| 1,3-Dichlorobenzene | N/A | -- | -- | -- | -- | No |
| 1,4-Dichlorobenzene | N/A | -- | -- | -- | -- | No |
| 2-Butanone | N/A | -- | -- | -- | -- | No |
| 2-Chlorophenol | No | -- | -- | -- | -- | No |
| 2-Methylnaphthalene | No | -- | -- | -- | -- | No |
| 3,3'-Dichlorobenzidine | N/A | -- | -- | -- | -- | No |
| 4-Chloro-3-methylphenol | N/A | -- | -- | -- | -- | No |
| 4-Methyl-2-pentanone | No | -- | -- | -- | -- | No |
| Acenaphthene | N/A | -- | -- | -- | -- | No |
| Acenaphthalene | N/A | -- | -- | -- | -- | No |
| Acetone | No | -- | -- | -- | -- | No |
| alpha-BHC | No | -- | -- | -- | -- | No |
| Anthracene | N/A | -- | -- | -- | -- | No |
| Benzo(a)anthracene | N/A | -- | -- | -- | -- | No |
| Benzo(a)pyrene | No | -- | -- | -- | -- | No |
| Benzo(b)fluoranthene | N/A | -- | -- | -- | -- | No |

**Table 7.16**

**Summary of ECOPC Screening Steps for Subsurface Soil in the UWOEU**

| Analyte | Exceed Any NOAEL ESL? | Frequency of Detection >5%? | Exceeds Background?[a] | Upper Bound EPC > Limiting ESL? | Professional Judgment Retain? | Retain as ECOPC? |
|---|---|---|---|---|---|---|
| Benzo(g,h,i)perylene | N/A | -- | -- | -- | -- | No |
| Benzo(k)fluoranthene | N/A | -- | -- | -- | -- | No |
| Benzoic Acid | N/A | -- | -- | -- | -- | No |
| bis(2-ethylhexyl)phthalate | No | -- | -- | -- | -- | No |
| Bromoform | No | -- | -- | -- | -- | No |
| Butylbenzylphthalate | No | -- | -- | -- | -- | No |
| Chrysene | N/A | -- | -- | -- | -- | No |
| cis-1,2-Dichloroethene | No | -- | -- | -- | -- | No |
| Di-n-butylphthalate | No | -- | -- | -- | -- | No |
| Di-n-octylphthalate | No | -- | -- | -- | -- | No |
| Dibenz(a,h)anthracene | N/A | -- | -- | -- | -- | No |
| Dibenzofuran | No | -- | -- | -- | -- | No |
| Diethylphthalate | No | -- | -- | -- | -- | No |
| Fluoranthene | N/A | -- | -- | -- | -- | No |
| Fluorene | N/A | -- | -- | -- | -- | No |
| Heptachlor epoxide | No | -- | -- | -- | -- | No |
| Hexachlorobenzene | No | -- | -- | -- | -- | No |
| Indeno(1,2,3-cd)pyrene | N/A | -- | -- | -- | -- | No |
| Isophorone | N/A | -- | -- | -- | -- | No |
| Methylene Chloride | No | -- | -- | -- | -- | No |
| Naphthalene | No | -- | -- | -- | -- | No |
| PCB-1254 | No | -- | -- | -- | -- | No |
| PCB-1260 | No | -- | -- | -- | -- | No |
| Total PCBs | No | -- | -- | -- | -- | No |
| Pentachlorophenol | No | -- | -- | -- | -- | No |
| Phenanthrene | N/A | -- | -- | -- | -- | No |
| Phenol | No | -- | -- | -- | -- | No |
| Pyrene | N/A | -- | -- | -- | -- | No |
| Tetrachloroethane | N/A | -- | -- | -- | -- | No |
| Toluene | No | -- | -- | -- | -- | No |
| Total Dioxins | No | -- | -- | -- | -- | No |
| Trichloroethene | No | -- | -- | -- | -- | No |
| **Radionuclides** | | | | | | |
| Americium-241 | No | -- | -- | -- | -- | No |
| Cesium-137 | No | -- | -- | -- | -- | No |
| Gross Alpha | N/A | -- | -- | -- | -- | No |
| Gross Beta | N/A | -- | -- | -- | -- | No |
| Plutonium-238 | N/A | -- | -- | -- | -- | No |
| Plutonium-239/240 | No | -- | -- | -- | -- | No |
| Radium-226 | No | -- | -- | -- | -- | No |
| Radium-228 | No | -- | -- | -- | -- | No |
| Strontium-89/90 | No | -- | -- | -- | -- | No |
| Uranium-233/234 | No | -- | -- | -- | -- | No |
| Uranium-235 | No | -- | -- | -- | -- | No |
| Uranium-238 | No | -- | -- | -- | -- | No |

[a] Based on results of statistical analysis at the 0.1 level of significance.

-- = Screen not performed because ECOI did not pass the previous screen.

N/A- Not applicable; ESL not available or background screen could not be conducted.

**Table 8.1**
**Summary of ECOPC/Receptor Pairs**

| ECOPC | Receptors of Potential Concern |
|---|---|
| **Surface Soil** | |
| Antimony | Terrestrial plant<br>Deer mouse (insectivore)<br>Coyote (insectivore) |
| Copper | Mourning dove (herbivore)<br>Mourning dove (insectivore) |
| Nickel | Mourning dove (insectivore)<br>Deer mouse (herbivore)<br>Deer mouse (insectivore)<br>Coyote (generalist)<br>Coyote (insectivore) |
| Silver | Terrestrial plant |
| Tin | American kestrel<br>Mourning dove (insectivore)<br>Deer mouse (insectivore) |
| Uranium | Terrestrial plant |
| Vanadium | Terrestrial plant<br>Deer mouse (insectivore) |
| Bis(2-ethylhexyl)phthalate | American kestrel<br>Mourning dove (insectivore) |
| Di-n-butylphthalate | American kestrel<br>Mourning dove (insectivore) |
| Dioxin TEQ (Total) | American kestrel<br>Mourning dove (insectivore)<br>Deer mouse (herbivore)<br>Deer mouse (insectivore)<br>Coyote (generalist)<br>Coyote (insectivore) |
| PCB (Total) | American kestrel<br>Mourning dove (herbivore)<br>Mourning dove (insectivore) |
| **Surface Soil - PMJM** | |
| Antimony | PMJM |
| Chromium | PMJM |
| Copper | PMJM |
| Manganese | PMJM |
| Molybdenum | PMJM |
| Nickel | PMJM |
| Tin | PMJM |
| Vanadium | PMJM |
| Zinc | PMJM |
| PCB (Total) | PMJM |
| **Subsurface Soil** | |
| None | None |

**Table 8.2**
**Surface Soil Exposure Point Concentrations for Non-PMJM Receptors**

| ECOPC | Tier I Exposure Point Concentrations (mg/kg) | | Tier II Exposure Point Concentrations (mg/kg) | |
|---|---|---|---|---|
| | UTL | UCL | UTL | UCL |
| **Inorganics (mg/kg)** | | | | |
| Antimony | 7.35 | 7.86 | 6.74 | 4.67 |
| Copper | 68.3 | 38.5 | 16.8 | 15 |
| Nickel | 21.1 | 14 | 13.3 | 12.1 |
| Silver | 3.3 | 9.69 | 0.966 | 0.633 |
| Tin | 21.1 | 12.7 | 7.22 | 5.07 |
| Uranium | 85 | 55.8 | 5.66 | 3.64 |
| Vanadium | 47 | 32.1 | 36.1 | 33.8 |
| **Organics (ug/kg)** | | | | |
| Bis(2-ethylhexyl)phthalate | 410 | 443 | 275 | 243 |
| Di-n-butylphthalate | 410 | 302 | 277 | 246 |
| Dioxin TEQ (total) mammal | 0.074 | 0.055 | N/A | N/A |
| Dioxin TEQ (total) bird | 0.126 | 0.096 | N/A | N/A |
| PCB (Total) | 1300 | 727 | 202 | 154 |

N/A - Tier II UTLs and UCLs could not be calculated because there were not enough data points on a grid cell basis.

**Table 8.3**

**Surface Soil Exposure Point Concentrations in PMJM Patches**

| Analyte[a] | Number of Samples | Number of Detects | Frequency of Detection | Minimum Detected Concentration (mg/kg) | Maximum Detected Concentration (mg/kg) | Arithmetic Mean Concentration (mg/kg) | UTL (mg/kg) | UCL (mg/kg) |
|---|---|---|---|---|---|---|---|---|
| **Patch 19** | | | | | | | | |
| Antimony | 10 | 1 | 10% | 0.15 | 8.8 | 4.77 | 12.33 | 6.61 |
| Chromium | 10 | 10 | 100% | 8.5 | 26 | 17.18 | 29.99 | 20.30 |
| Manganese | 10 | 10 | 100% | 199 | 555 | 334.7 | 602.83 | 399.94 |
| Nickel | 10 | 9 | 90% | 2.3 | 19.3 | 12.88 | 25.79 | 16.02 |
| Tin | 10 | 4 | 40% | 0.46 | 66.9 | 13.426 | 67.85 | 26.67 |
| Vanadium | 10 | 10 | 100% | 23.5 | 53 | 39.03 | 63.09 | 44.88 |
| Zinc | 10 | 10 | 100% | 28.8 | 160 | 75.62 | 185.03 | 102.24 |
| **Patch 20** | | | | | | | | |
| Antimony | 12 | 2 | 16.6% | 2.45 | 49.8 | 10.55 | 46.43 | 18.90 |
| Chromium | 17 | 17 | 100% | 3.7 | 24.2 | 14.29 | 24.17 | 16.37 |
| Copper | 17 | 17 | 100% | 10.2 | 112 | 32.48 | 93.54 | 45.35 |
| Manganese | 17 | 17 | 100% | 158 | 829 | 293.00 | 617.48 | 361.40 |
| Molybdenum | 17 | 1 | 6% | 0.55 | 4.4 | 1.22 | 3.05 | 1.61 |
| Nickel | 16 | 16 | 100% | 8.8 | 26.3 | 14.74 | 23.37 | 16.59 |
| Vanadium | 17 | 17 | 100% | 17.5 | 43.6 | 29.44 | 44.38 | 32.59 |
| Zinc | 17 | 17 | 100% | 39.3 | 199 | 81.30 | 167.83 | 99.54 |
| PCBs - total | 15 | 5 | 33% | 0.055 | 3.9 | 0.79 | 3.18 | 1.31 |
| **Patch 21** | | | | | | | | |
| Antimony | 7 | 1 | 14% | 0.33 | 6.5 | 4.38 | 9.85 | 5.80 |
| Chromium | 7 | 7 | 100% | 2.6 | 23.3 | 14.03 | 33.06 | 18.98 |
| Manganese | 7 | 7 | 100% | 134 | 476 | 358 | 704 | 448 |
| Molybdenum | 6 | 3 | 50% | 1.1 | 2.25 | 1.84 | 3.26 | 2.22 |
| Nickel | 7 | 5 | 71% | 4.25 | 21.1 | 12.1 | 29.0 | 16.5 |
| Tin | 7 | 2 | 29% | 0.45 | 47.6 | 21.8 | 70.2 | 34.4 |
| Vanadium | 7 | 7 | 100% | 9.9 | 47 | 36.0 | 74.9 | 46.1 |
| Zinc | 7 | 7 | 100% | 21.2 | 72 | 51.0 | 99.7 | 63.7 |

Notes:

[a] ECOPCs shown on this table were detected at least once in a given patch and are only those that have patch-specific MDCs > ESL.

**Table 8.4**
**Surface Water Exposure Point Concentrations for Non-PMJM and PMJM Receptors**

| ECOPC | MDC | 95th UTL | 95th UCL | Mean |
|---|---|---|---|---|
| **Inorganics (mg/L)** | | | | |
| Antimony | 0.08 | 0.025 | 0.009 | 0.007 |
| Chromium | 0.348 | 0.024 | 0.008 | 0.01 |
| Copper | 0.259 | 0.046 | 0.016 | 0.013 |
| Manganese | 7.77 | 0.665 | 0.188 | 0.209 |
| Molybdenum | 0.028 | 0.006 | 0.003 | 0.003 |
| Nickel | 0.272 | 0.021 | 0.013 | 0.01 |
| Silver | 0.031 | 0.003 | 0.001 | 0.001 |
| Tin | 0.07 | 0.023 | 0.01 | 0.007 |
| Uranium | 0.077 | 0.062 | 0.021 | 0.01 |
| Vanadium | 0.747 | 0.04 | 0.017 | 0.02 |
| Zinc | 2.19 | 0.395 | 0.131 | 0.113 |
| **Organics (ug/L)** | | | | |
| Bis(2-ethylhexyl)phthalate | 26 | 13 | 14 | 7.15 |
| Di-n-butylphthalate | 5 | 5.5 | 5.04 | 4.87 |
| Dioxin TEQ (total) | N/A | | | |
| PCB (total) | N/A | | | |

N/A = Data were not available.

## Table 8.5
## Receptor-Specific Exposure Parameters

| Receptor | Body Weight (kg) | Body Weight Reference | Percentage of Diet: Plant Tissue | Percentage of Diet: Invertebrate Tissue | Percentage of Diet: Bird or Mammal Tissue | Percentage of Diet: Dietary Reference | Food Ingestion Rate (kg/kg BW day$^{-1}$) | Ingestion Rate Reference | Water Ingestion Rate (L/kg BW day$^{-1}$) | Ingestion Rate Reference | Percentage of Diet as Soil | Soil Ingestion Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Non-Wildlife Terrestrial Receptors** | | | | | | | | | | | | |
| Terrestrial Plants | | | | | | | N/A | | | | | |
| Terrestrial Invertebrates | | | | | | | N/A | | | | | |
| **Vertebrate Receptors - Birds** | | | | | | | | | | | | |
| American kestrel | 0.116 | Brown and Amadon (1968) - Average value | 0 | 20 | 80 | Generalized Diet from several studies presented in the Watershed ERA DOE (1996) | 0.092 | Kolpin et al. (1980) | 0.12 | EPA (1993) - Estimated using model for all birds - Calder and Braun (1983) | 5 | Assumed value based on conservative estimates for carnivores |
| Mourning Dove (herbivore) | 0.113 | Average of adult values from CalEPA (2004) Online Database | 100 | 0 | 0 | Cowan (1952) | 0.23 | EPA (2003) | 0.12 | EPA (1993) - Estimated using model for all birds - Calder and Braun (1983) | 9.3 | Beyer et al. (1994) - Wild turkey used as a surrogate. |
| Mourning Dove (insectivore) | 0.113 | Average of adult values from CalEPA (2004) Online Database | 0 | 100 | 0 | Generalized Diet | 0.23 | EPA (2003) | 0.12 | EPA (1993) - Estimated using model for all birds - Calder and Braun (1983) | 9.3 | Beyer et al. (1994) - Wild turkey used as a surrogate. |
| **Vertebrate Receptors - Mammals** | | | | | | | | | | | | |
| Preble's Meadow Jumping Mouse | 0.019 | Morrison and Ryser (1962) | 70 | 30 | 0 | Estimated from Whitacker (1972) | 0.17 | EPA (1993) - Estimated- Nagy (1987) - Rodent Model | 0.15 | EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983) | 2.4 | Beyer et al. (1994) - Meadow Vole used as a conservative surrogate |
| Deer Mouse (herbivore) | 0.0187 | Flake (1973) | 100 | 0 | 0 | Generalized Diet | 0.111 | Cronin and Bradley (1988) | 0.19 | Ross (1930); Dice (1922) as cited in EPA (1993). | 2 | Beyer et al. (1994) |
| Deer Mouse (insectivore) | 0.0187 | Flake (1973) | 0 | 100 | 0 | Generalized Diet | 0.065 | Cronin and Bradley (1988) | 0.19 | Ross (1930); Dice (1922) as cited in USEPA 1993. | 2 | Beyer et al. (1994) |

Table 8.5
Receptor-Specific Exposure Parameters

| Receptor | Body Weight (kg) | Body Weight Reference | Percentage of Diet | | | | Food Ingestion Rate (kg/kg BW day$^{-1}$) | Ingestion Rate Reference | Water Ingestion Rate (L/kg BW day$^{-1}$) | Ingestion Rate Reference | Percentage of Diet as Soil | Soil Ingestion Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Plant Tissue | Invertebrate Tissue | Bird or Mammal Tissue | Dietary Reference | | | | | | |
| Coyote (generalist) | 12.75 | Bekoff (1977) - Average of male and female weights | 0 | 25 | 75 | Generalized Diet | 0.015 | Gier (1975) | 0.08 | EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983) | 5 | Beyer et al. (1994) - High end estimate for Red Fox |
| Coyote (insectivore) | 12.75 | Bekoff (1977) - Average of male and female weights | 0 | 100 | 0 | Generalized Diet | 0.015 | Gier (1975) | 0.08 | EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983) | 2.8 | Beyer et al. (1994) - Red Fox |

Receptor parameters for all receptors with the exception of the prairie dog and mourning dove were taken from the Watershed Risk Assessment (DOE 1996) and referenced to the original source.

All receptor parameters are estimates of central tendency except where noted.

All values are presented in a dry weight basis.

N/A = Not applicable.

**Table 8.6**
**Receptor-Specific Intake Estimates**

| | Intake Estimates (mg/kg BW day) | | | | | |
|---|---|---|---|---|---|---|
| | Plant Tissue | Invertebrate Tissue | Mammal Tissue | Soil | Surface Water | Total |
| **Default Exposure Estimates** | | | | | | |
| ***Antimony*** | | | | | | |
| Deer Mouse - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 4.78E-01 | N/A | 0.010 | 0.005 | 0.492 |
| Tier 2 95th UTL | N/A | 0.438 | N/A | 0.009 | 0.005 | 0.452 |
| Coyote - Insectivore | | | | | | |
| Tier 1 95th UCL | N/A | 0.110 | N/A | 0.003 | 0.002 | 0.150 |
| Tier 2 95th UCL | N/A | 0.101 | N/A | 0.003 | 0.002 | 0.106 |
| ***Copper*** | | | | | | |
| Mourning Dove - Herbivore | | | | | | |
| Tier 1 95th UTL | 2.37E+00 | N/A | N/A | 1.461 | 0.006 | 3.84 |
| Tier 2 95th UTL | 1.36E+00 | N/A | N/A | 0.359 | 0.006 | 1.73 |
| Mourning Dove - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 3.745 | N/A | 1.461 | 0.006 | 5.21 |
| Tier 2 95th UTL | N/A | 2.586 | N/A | 0.359 | 0.006 | 2.95 |
| ***Nickel*** | | | | | | |
| Mourning Dove - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 2.30E+01 | N/A | 0.451 | 0.003 | 23.41 |
| Tier 2 95th UTL | N/A | 1.45E+01 | N/A | 0.284 | 0.003 | 14.8 |
| Deer Mouse - Herbivore | | | | | | |
| Tier 1 95th UTL | 0.117 | N/A | N/A | 0.047 | 0.004 | 0.17 |
| Tier 2 95th UTL | 0.083 | N/A | N/A | 0.030 | 0.004 | 0.117 |
| Deer Mouse - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 6.49E+00 | N/A | 0.027 | 0.004 | 6.52 |
| Tier 2 95th UTL | N/A | 4.09E+00 | N/A | 0.017 | 0.004 | 4.11 |
| Coyote - Generalist | | | | | | |
| Tier 1 95th UCL | N/A | 2.48E-01 | 3.01E-02 | 0.011 | 1.04E-03 | 0.290 |
| Tier 2 95th UCL | N/A | 2.15E-01 | 2.81E-02 | 0.009 | 1.04E-03 | 0.253 |
| Coyote - Insectivore | | | | | | |
| Tier 1 95th UCL | N/A | 9.93E-01 | N/A | 0.006 | 1.04E-03 | 1.000 |
| Tier 2 95th UCL | N/A | 8.58E-01 | N/A | 0.005 | 1.04E-03 | 0.865 |
| ***Tin*** | | | | | | |
| Mourning Dove - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 4.853 | N/A | 0.451 | 0.003 | 5.31 |
| Tier 2 95th UTL | N/A | 1.661 | N/A | 0.154 | 0.003 | 1.818 |
| American Kestrel | | | | | | |
| Tier 1 95th UTL | N/A | 0.388 | 3.26E-01 | 0.097 | 0.003 | 0.81 |
| Tier 2 95th UTL | N/A | 0.133 | 1.12E-01 | 0.033 | 0.003 | 0.280 |
| Deer Mouse - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 1.372 | N/A | 0.027 | 0.004 | 1.403 |
| Tier 2 95th UTL | N/A | 0.469 | N/A | 0.009 | 0.004 | 0.483 |
| ***Vanadium*** | | | | | | |
| Deer Mouse - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 0.269 | N/A | 0.061 | 0.008 | 0.338 |
| Tier 2 95th UTL | N/A | 0.206 | N/A | 0.047 | 0.008 | 0.261 |
| ***Bis(2-ethylhexyl)phthalate*** | | | | | | |
| Mourning Dove - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 3.29 | N/A | 0.009 | 0.002 | 3.30 |
| Tier 2 95th UTL | N/A | 2.21 | N/A | 0.006 | 0.002 | 2.21 |
| American Kestrel | | | | | | |
| Tier 1 95th UTL | N/A | 0.263 | 8.69E-01 | 0.002 | 0.002 | 1.14 |
| Tier 2 95th UTL | N/A | 0.18 | 5.83E-01 | 0.001 | 0.002 | 0.76 |

**Table 8.6**
**Receptor-Specific Intake Estimates**

| | Intake Estimates (mg/kg BW day) | | | | | |
|---|---|---|---|---|---|---|
| | Plant Tissue | Invertebrate Tissue | Mammal Tissue | Soil | Surface Water | Total |
| **Default Exposure Estimates** | | | | | | |
| ***Di-n-butylphthalate*** | | | | | | |
| Mourning Dove - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 2.84 | N/A | 0.009 | 6.60E-04 | 2.85 |
| Tier 2 95th UTL | N/A | 1.92 | N/A | 0.006 | 6.60E-04 | 1.92 |
| American Kestrel | | | | | | |
| Tier 1 95th UTL | N/A | 0.227 | 0.858 | 0.002 | 6.60E-04 | 1.09 |
| Tier 2 95th UTL | N/A | 0.153 | 0.579 | 0.001 | 6.60E-04 | 0.734 |
| ***Dioxin (Total)*** | | | | | | |
| Mourning Dove - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 1.64E-04 | N/A | 2.70E-06 | ND | 1.67E-04 |
| Tier 2 95th UTL | N/A | N/A | N/A | N/A | N/A | N/A |
| American Kestrel | | | | | | |
| Tier 1 95th UTL | N/A | 1.31E-05 | 8.56E-06 | 5.80E-07 | ND | 2.23E-05 |
| Tier 2 95th UTL | N/A | N/A | N/A | N/A | N/A | N/A |
| Deer Mouse - Herbivore | | | | | | |
| Tier 1 95th UTL | 0.000 | N/A | N/A | 1.64E-07 | ND | 1.97E-06 |
| Tier 2 95th UTL | N/A | N/A | N/A | N/A | N/A | N/A |
| Deer Mouse - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 2.45E-05 | N/A | 9.62E-08 | ND | 2.46E-05 |
| Tier 2 95th UTL | N/A | N/A | N/A | N/A | N/A | N/A |
| Coyote - Generalist | | | | | | |
| Tier 1 95th UCL | N/A | 9.90E-07 | 5.26E-07 | 4.13E-08 | ND | 1.56E-06 |
| Tier 2 95th UCL | N/A | N/A | N/A | N/A | N/A | N/A |
| Coyote - Insectivore | | | | | | |
| Tier 1 95th UCL | N/A | 3.96E-06 | N/A | 2.31E-08 | ND | 3.98E-06 |
| Tier 2 95th UCL | N/A | N/A | N/A | N/A | N/A | N/A |
| ***PCB (Total)*** | | | | | | |
| Mourning Dove - Herbivore | | | | | | |
| Tier 1 95th UTL | 7.48E-02 | N/A | N/A | 0.028 | ND | 0.10 |
| Tier 2 95th UTL | 1.16E-02 | N/A | N/A | 0.004 | ND | 0.02 |
| Mourning Dove - Insectivore | | | | | | |
| Tier 1 95th UTL | N/A | 1.35E+00 | N/A | 0.028 | ND | 1.37 |
| Tier 2 95th UTL | N/A | 1.07E-01 | N/A | 0.004 | ND | 0.11 |
| American Kestrel | | | | | | |
| Tier 1 95th UTL | N/A | 0.11 | 1.32E-01 | 0.006 | ND | 0.25 |
| Tier 2 95th UTL | N/A | 0.01 | 1.01E-01 | 0.001 | ND | 0.11 |
| **Alternative Exposure Estimates** | | | | | | |
| Deer Mouse - Insectivore | | | | | | |
| Tier 1 95th UTL | NA | 1.45 | NA | 0.027 | 0 | 1.48 |
| Tier 2 95th UTL | NA | 0.92 | NA | 0.017 | 0 | 0.94 |

ND = Not detected

## Table 8.7
## PMJM Intake Estimates

| | Intake Estimates (mg/kg BW/day) | | | | | |
|---|---|---|---|---|---|---|
| | Plant Tissue | Invertebrate Tissue | Mammal Tissue | Soil | Surface Water | Total |
| **Default Exposure Estimates** | | | | | | |
| ***Antimony*** | | | | | | |
| Patch 19 | | | | | | |
| UCL | 2.76E-02 | 3.37E-01 | N/A | 2.70E-02 | 1.35E-03 | 3.93E-01 |
| Patch 20 | | | | | | |
| UCL | 7.39E-02 | 9.64E-01 | N/A | 7.71E-02 | 1.35E-03 | 1.12E+00 |
| Patch 21 | | | | | | |
| UCL | 2.44E-02 | 2.96E-01 | N/A | 2.37E-02 | 1.35E-03 | 3.45E-01 |
| ***Chromium*** | | | | | | |
| Patch 19 | | | | | | |
| UCL | 2.03E-01 | 3.27E+00 | N/A | 8.28E-02 | 1.20E-03 | 3.56E+00 |
| Patch 20 | | | | | | |
| UCL | 1.64E-01 | 2.64E+00 | N/A | 6.68E-02 | 1.20E-03 | 2.87E+00 |
| Patch 21 | | | | | | |
| UCL | 1.90E-01 | 3.06E+00 | N/A | 7.74E-02 | 1.20E-03 | 3.33E+00 |
| ***Copper*** | | | | | | |
| Patch 20 | | | | | | |
| UCL | 1.04E+00 | 7.45E-01 | N/A | 1.85E-01 | 2.40E-03 | 1.98E+00 |
| ***Manganese*** | | | | | | |
| Patch 19 | | | | | | |
| UCL | 1.11E+01 | 6.82E+00 | N/A | 1.63E+00 | 2.82E-02 | 1.96E+01 |
| Patch 20 | | | | | | |
| UCL | 1.01E+01 | 6.36E+00 | N/A | 1.47E+00 | 2.82E-02 | 1.79E+01 |
| Patch 21 | | | | | | |
| UCL | 1.25E+01 | 7.37E+00 | N/A | 1.83E+00 | 2.82E-02 | 2.17E+01 |
| ***Molybdenum*** | | | | | | |
| Patch 20 | | | | | | |
| UCL | 4.79E-02 | 1.72E-01 | N/A | 6.57E-03 | 4.50E-04 | 2.27E-01 |
| Patch 21 | | | | | | |
| UCL | 6.60E-02 | 2.37E-01 | N/A | 9.06E-03 | 4.50E-04 | 3.12E-01 |
| ***Nickel*** | | | | | | |
| Patch 19 | | | | | | |
| UCL | 1.03E-01 | 3.86E+00 | N/A | 6.54E-02 | 1.95E-03 | 4.03E+00 |
| Patch 20 | | | | | | |
| UCL | 1.05E-01 | 4.00E+00 | N/A | 6.77E-02 | 1.95E-03 | 4.18E+00 |
| Patch 21 | | | | | | |
| UCL | 1.05E-01 | 3.97E+00 | N/A | 6.71E-02 | 1.95E-03 | 4.14E+00 |
| ***Tin*** | | | | | | |
| Patch 19 | | | | | | |
| UCL | 9.52E-02 | 1.36E+00 | N/A | 1.09E-01 | 1.50E-03 | 1.57E+00 |
| Patch 21 | | | | | | |
| UCL | 1.23E-01 | 1.76E+00 | N/A | 1.40E-01 | 1.50E-03 | 2.02E+00 |
| ***Vanadium*** | | | | | | |
| Patch 19 | | | | | | |
| UCL | 5.18E-02 | 2.01E-01 | N/A | 1.83E-01 | 2.55E-03 | 4.39E-01 |
| Patch 20 | | | | | | |
| UCL | 3.76E-02 | 1.46E-01 | N/A | 1.33E-01 | 2.55E-03 | 3.19E-01 |
| Patch 21 | | | | | | |
| UCL | 5.32E-02 | 2.07E-01 | N/A | 1.88E-01 | 2.55E-03 | 4.51E-01 |
| ***Zinc*** | | | | | | |
| Patch 19 | | | | | | |

**Table 8.7**
**PMJM Intake Estimates**

| | Intake Estimates (mg/kg BW day) | | | | | |
|---|---|---|---|---|---|---|
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| **Default Exposure Estimates** | | | | | | |
| UCL | 7.46E+00 | 1.99E+01 | N/A | 4.17E-01 | 1.97E-02 | 2.78E+01 |
| Patch 20 | | | | | | |
| UCL | 7.35E+00 | 1.97E+01 | N/A | 4.06E-01 | 1.97E-02 | 2.75E+01 |
| Patch 21 | | | | | | |
| UCL | 5.74E+00 | 1.70E+01 | N/A | 2.60E-01 | 1.97E-02 | 2.31E+01 |
| ***PCB (Total)*** | | | | | | |
| Patch 20 | | | | | | |
| UCL | 3.91E-02 | 3.03E-01 | N/A | 5.36E-03 | N/A | 3.47E-01 |
| **Alternative Exposure Estimates** | | | | | | |
| ***Nickel*** | | | | | | |
| Patch 19 | | | | | | |
| UCL | 1.03E-01 | 8.65E-01 | N/A | 6.54E-02 | 1.95E-03 | 1.04E+00 |
| Patch 20 | | | | | | |
| UCL | 1.05E-01 | 8.96E-01 | N/A | 6.77E-02 | 1.95E-03 | 1.07E+00 |
| Patch 21 | | | | | | |
| UCL | 1.05E-01 | 8.88E-01 | N/A | 6.71E-02 | 1.95E-03 | 1.06E+00 |

N/A = Not applicable.

**Table 9.1**
**TRVs for Terrestrial Plant and Invertebrate Receptors**

| ECOPC | Soil Concentration (mg/kg) | Endpoint | Effect Measured/Observed | Reference | Notes |
|---|---|---|---|---|---|
| **Terrestrial Plants** | | | | | |
| Antimony | 5 | Screening ESL | Based on a report of unspecified toxic effects on plants grown in surface soil. | Kabata-Pendias and Pendias 1984 as cited in Efroymson et al. 1997a | Low confidence in value. |
| Silver | 2 | Screening ESL | Based on a report of unspecified toxic effects on plants grown in surface soil. | Kabata-Pendias and Pendias 1984 as cited in Efroymson et al. 1997a | Low confidence in value. |
| Uranium | 5 | Screening ESL | Reduction in root weight in sandy soil. | Sheppard et al. 1982 as cited in Efroymson et al 1997a | Low confidence in value. |
| Vanadium | 2 | Screening ESL | Value was not based on any specific study. | Efroymson et al. 1997a | Low confidence in value. |

Table 9.2
TRVs for Terrestrial Vertebrate Receptors

| ECOPC | NOAEL (mg/kg day) | NOAEL Endpoint | Lowest Bounded LOAEL (mg/kg day) | LOAEL Endpoint | TRV Source | Uncertainty Factor | Final NOAEL (mg/kg day) | Threshold (mg/kg day) | Rationale For Calculation | TRV Confidence |
|---|---|---|---|---|---|---|---|---|---|---|
| **Birds** | | | | | | | | | | |
| Copper | 2.3 | No effects noted | 52.3 | Increase in chicken gizzard erosion | PRC (1994) | 1 | 2.30 | N/A | Threshold was not calculated. | High |
| Nickel | 1.38 | No increase in tremors or toe and leg joint edema | 55.26 | Increase in tremors and toe and knee joint edema in mallard. | PRC (1994) | 1 | 1.38 | 8.7 | The nature of the effect is not likely to cause a significant effect on growth, reproduction or survival. Thus, the data satisfy the requirements described in the text for calculating a threshold. | High |
| Tin (Butyltins) | 0.73 | No change in Japanese quail growth and reproduction. | 18.34 | Decrease in Japanese quail reproduction | PRC (1994) | 1 | 0.73 | N/A | The original paper was not reviewed. Not enough information was available to calculate the threshold TRV | High |
| bis(2-ethylhexyl)phthalate | 1.1 | No reproductive effects in ringed doves | 214 | Increase in European starling body weight. | Sample et al. (1996)/O'Shea and Stafford (1980) | 1 | 1.1 | N/A | Threshold was not calculated. | NOAEL High/LOAEL Low. |
| Di-n-butylphthalate | 0.11 | NOAEL estimated from LOAEL | 1.1 | Reduction in eggshell thickness and water permeability in ringed doves | Sample et al. (1996) | 1 | 0.110 | N/A | NOAEL was estimated from the LOAEL. | High |
| Dioxin (Total) | 1.40E-05 | No effect on pheasant egg production and hatchability | 1.40E-04 | Decrease in egg production and hatchability | Sample et al. (1996) | 1 | 1.40E-05 | N/A | Original study was not reviewed and not enough information is presented in Sample et al. (1996) to meet threshold criteria calculation. | High |
| PCB (total | 0.09 | NOAEL was estimated from LOAEL | 1.27 | Decrease in egg hatchability | PRC (1994) | 1 | 0.09 | N/A | NOAEL was estimated from the LOAEL. | High |
| **Mammals** | | | | | | | | | | |
| Antimony | 0.06 | No change to rat progeny weight | 0.59 | Decrease in rat progeny weight | EPA (2003) | 1 | 0.06 | N/A | The original paper was not reviewed. Not enough information was available to calculate the threshold TRV | Very High |
| Chromium III | 2,737 | No effects on rat reproduction and life span | NA | No effects at the highest study dose | Sample et al. (1996) | 1 | 2,737 | NA | Threshold not provided in CRA Methodology. | High |
| Chromium VI | 3.28 | No effects on rat body weight or food consumption | 13.14 | Increased mortality in rats | Sample et al. (1996) | 1 | 3.28 | 6.58 | Threshold calculated for risk characterization purposes | High |

Table 9.2
TRVs for Terrestrial Vertebrate Receptors

| ECOPC | NOAEL (mg/kg day) | NOAEL Endpoint | Lowest Bounded LOAEL (mg/kg day) | LOAEL Endpoint | TRV Source | Uncertainty Factor | Final NOAEL (mg/kg day) | Threshold (mg/kg day) | Rationale For Calculation | TRV Confidence |
|---|---|---|---|---|---|---|---|---|---|---|
| Copper | 2.67 | No immune response effects | 631.58 | Increased mortality and decreased body weight in mice. | PRC (1994) | 1 | 2.67 | N/A | Not enough data available for calculation of threshold. | High |
| Manganese | 13.7 | No change in mouse testicle weight | 159.1 | Decrease in mouse testicle weight | PRC (1994) | 1 | 13.7 | 46 | Threshold calculated for risk characterization purposes | High |
| Molybdenum | 0.26 | NOAEL estimated from LOAEL | 2.6 | Increased incidence of runts in mice litters | Sample et al. (1996) | 1 | 0.26 | N/A | NOAEL was estimated from LOAEL. | High |
| Nickel | 0.133 | NOAEL was estimated from LOAEL | 1.33 | Increase in pup mortality in rats | PRC (1994) | 1 | 0.133 | N/A | NOAEL was estimated from LOAEL | High |
| Tin (Butyltins) | 0.25 | No systemic effects | 15 | Midrange of effects less than mortality | PRC (1994) | 1 | 0.25 | 1.94 | Threshold calculated for risk characterization purposes | High |
| Vanadium | 0.21 | NOAEL estimated from LOAEL | 2.1 | Significant reproductive effects in rats | Sample et al. (1996) | 1 | 0.21 | N/A | NOAEL was estimated from the LOAEL. | High |
| Zinc | 9.61 | NOAEL was estimated from LOAEL | 411.4 | Increase in fetal developmental effects in rats | PRC (1994) | 1 | 9.61 | N/A | NOAEL was estimated from LOAEL | High |
| Dioxin (Total) | 1.00E-06 | No reproductive effects in rats | 1.00E-05 | Decreased fertility and neonatal survival in rats | Sample et al. (1996) | 1 | 1.00E-06 | N/A | Original study was not reviewed and not enough information is presented in Sample et al. (1996) to meet threshold criteria calculation. | High |
| PCBs (Total) | 0.36 | No increase in mouse liver weight | 0.71 | Decrease in mouse reproductive capacity | PRC (1994) | 1 | 0.36 | 0.51 | The magnitude of the response was small. Thus, the data satisfy the requirements described in the text for calculating a threshold. | High |

Threshold TRVs were independently calculated using the procedures outlined in the CRA Methodology, Section 3.1.4.

TRV Confidence:

N/A = No TRV has been identified or the TRV has been deemed unacceptable for use in ECOPC selection.
Low = TRVs that have data for only one species looking at one endpoint (non-mortality) and from one primary literature source.
Moderate = TRVs that have multiple primary literature sources looking at one endpoint (non-mortality or mortality) but with only one species evaluated.
Good = For TRVs that have either multiple species with one endpoint from multiple studies or those TRVs with multiple species and multiple endpoints from only one study.
High = For TRVs that have multiple study sources looking at multiple endpoints and more than one species.
Very High = All EcoSSLs (EPA 2003a) will be assigned this level of confidence by default.

**Table 10.1**
**Hazard Quotient Summary for Non-PMJM Receptors**

| ECOPC | Receptor | BAF | EPC | Hazard Quotients (HQs) Based on Default TRVs | Hazard Quotients (HQs) Based on Alternate TRVs (Uncertainty Analysis) |
|---|---|---|---|---|---|
| Antimony | Terrestrial Plants | N/A | Tier 1 | UTL = 1 | No alternative TRVs identified. |
| | | | Tier 2 | UTL = 1 | No alternative TRVs identified. |
| | Deer Mouse (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 8 *LOAEL* UTL = 0.8 | NOAEL UTL = 0.04 |
| | | | Tier 2 | *NOAEL* UTL = 8 *LOAEL* UTL = 0.8 | NOAEL UTL = 0.03 |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | Coyote (Insectivore) | Default | Tier 1 | *NOAEL* UCL = 2 *LOAEL* UCL = 0.2 | NOAEL UCL = 0.01 |
| | | | Tier 2 | *NOAEL* UCL = 2 *LOAEL* UCL = 0.2 | NOAEL UCL = 0.01 |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| Copper | Mourning Dove (Herbivore) | Default | Tier 1 | *NOAEL* UTL = 2 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 0.8 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | Mourning Dove (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 2 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| Nickel | Mourning Dove (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 17 *Threshold* UTL = 3 *LOAEL* UTL = 0.4 | Not Calculated |
| | | | Tier 2 | *NOAEL* *UTL = 11* *Threshold* *UTL = 2* *LOAEL* *UTL = 0.3* | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | Deer Mouse (Herbivore) | Default | Tier 1 | *NOAEL* UTL = 1 *LOAEL* UTL = 0.1 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 0.9 *LOAEL* UTL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |

**Table 10.1**
**Hazard Quotient Summary for Non-PMJM Receptors**

| ECOPC | Receptor | BAF | EPC | Hazard Quotients (HQs) | |
|---|---|---|---|---|---|
| | | | | Based on Default TRVs | Based on Alternate TRVs (Uncertainty Analysis) |
| Nickel (continued) | Deer Mouse (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 49 *LOAEL* UTL = 5 | *NOAEL* UTL = 0.2 *LOAEL* UTL = 0.08 |
| | | | Tier 2 | *NOAEL* UTL = 31 *LOAEL* UTL = 3 | *NOAEL* UTL = 0.1 *LOAEL* UTL = 0.05 |
| | | Alternate (Uncertainty Analysis) | Tier 1 | *NOAEL* UTL = 11 *LOAEL* UTL = 1 | *NOAEL* UTL = 0.04 *LOAEL* UTL = 0.02 |
| | | | Tier 2 | *NOAEL* UTL = 7 *LOAEL* UTL = 0.7 | *NOAEL* UTL = 0.02 *LOAEL* UTL = 0.01 |
| | Coyote (Generalist) | Default | Tier 1 | *NOAEL* UCL = 3 *LOAEL* UCL = 0.3 | Not Calculated |
| | | | Tier 2 | *NOAEL* UCL = 2 *LOAEL* UCL = 0.2 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | Coyote (Insectivore) | Default | Tier 1 | *NOAEL* UCL = 11 *LOAEL* UCL = 1 | Not Calculated |
| | | | Tier 2 | *NOAEL* UCL = 7 *LOAEL* UCL = 0.7 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| Silver | Terrestrial Plants | N/A | Tier 1 | UTL = 2 | Not Calculated |
| | | | Tier 2 | UTL = 0.5 | Not Calculated |
| Tin | Mourning Dove (Herbivore) | Default | Tier 1 | *NOAEL* UTL = 1 *LOAEL* UTL = 0.03 | Not Calculated |
| | | | Tier 2 | *NOAEL* *UTL = 0.3* *LOAEL* *UTL = 0.01* | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | Mourning Dove (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 7 *LOAEL* UTL = 0.3 | Not Calculated |
| | | | Tier 2 | *NOAEL* *UTL = 2* *LOAEL* *UTL = 0.1* | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |

**Table 10.1**
**Hazard Quotient Summary for Non-PMJM Receptors**

| ECOPC | Receptor | BAF | EPC | Hazard Quotients (HQs) Based on Default TRVs | Hazard Quotients (HQs) Based on Alternate TRVs (Uncertainty Analysis) |
|---|---|---|---|---|---|
| Tin (continued) | American Kestrel | Default | Tier 1 | *NOAEL* UTL = 1 *LOAEL* UTL = 0.04 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 0.4 *LOAEL* UTL = 0.02 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | Deer Mouse (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 6 *LOAEL* UTL = 0.1 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 2 *LOAEL* UTL = 0.03 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| Uranium | Terrestrial Plants | N/A | Tier 1 | UTL = 17 | UTL = 9 |
| | | | Tier 2 | UTL = 1 | UTL = 0.6 |
| Vanadium | Terrestrial Plants | N/A | Tier 1 | UTL = 24 | LOEC UTL = 1 |
| | | | Tier 2 | UTL = 18 | LOEC UTL = 0.7 |
| | Deer Mouse (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 2 *LOAEL* UTL = 0.2 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 1 *LOAEL* UTL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| Bis(2-ethylhexyl)phthalate | Mourning Dove (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 3 *LOAEL* UTL = 0.02 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 2 *LOAEL* UTL = 0.01 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | American Kestrel | Default | Tier 1 | *NOAEL* UTL = 1 *LOAEL* UTL = 0.01 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 0.7 *LOAEL* UTL = 0.004 | Not Calculated |

Table 10.1
Hazard Quotient Summary for Non-PMJM Receptors

| ECOPC | Receptor | BAF | EPC | Hazard Quotients (HQs) Based on Default TRVs | Hazard Quotients (HQs) Based on Alternate TRVs (Uncertainty Analysis) |
|---|---|---|---|---|---|
| Bis(2-ethylhexyl)phthalate (continued) | American Kestrel (continued) | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| Di-n-butylphthalate | Mourning Dove (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 26 *LOAEL* UTL = 3 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 17 *LOAEL* UTL = 2 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | American Kestrel | Default | Tier 1 | *NOAEL* UTL = 10 *LOAEL* UTL = 1 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 7 *LOAEL* UTL = 0.7 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| 2,3,7,8-TCDD TEQ (Bird & Mammal) | Mourning Dove (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 12 *LOAEL* UTL = 1 | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | American Kestrel | Default | Tier 1 | *NOAEL* UTL = 2 *LOAEL* UTL = 0.2 | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | Deer Mouse (Herbivore) | Default | Tier 1 | *NOAEL* UTL = 2 *LOAEL* UTL = 0.2 | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | Deer Mouse (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 25 *LOAEL* UTL = 2 | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | Coyote (Generalist) | Default | Tier 1 | *NOAEL* UCL = 2 *LOAEL* UCL = 0.2 | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |

Table 10.1
Hazard Quotient Summary for Non-PMJM Receptors

| ECOPC | Receptor | BAF | EPC | Hazard Quotients (HQs) Based on Default TRVs | Hazard Quotients (HQs) Based on Alternate TRVs (Uncertainty Analysis) |
|---|---|---|---|---|---|
| 2,3,7,8-TCDD TEQ (Bird & Mammal) (continued) | Coyote (Insectivore) | Default | Tier 1 | *NOAEL* UCL = 6 *LOAEL* UCL = 0.6 | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| Total PCBs | Mourning Dove (Herbivore) | Default | Tier 1 | *NOAEL* UTL = 1 *LOAEL* UTL = 0.1 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 0.2 *LOAEL* UTL = 0.01 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | Mourning Dove (Insectivore) | Default | Tier 1 | *NOAEL* UTL = 15 *LOAEL* UTL = 1 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 1 *LOAEL* UTL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |
| | American Kestrel | Default | Tier 1 | *NOAEL* UTL = 3 *LOAEL* UTL = 0.2 | Not Calculated |
| | | | Tier 2 | *NOAEL* UTL = 1 *LOAEL* UTL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | Tier 1 | Not Calculated | Not Calculated |
| | | | Tier 2 | Not Calculated | Not Calculated |

Shaded cells represent default HQ calculations based on exposure and toxicity models specifically identified in the CRA Methodology
All HQ Calculations are provided in Attachment 4.
Discussion of the chemical-specific uncertainties are provided in Attachment 5.

**Table 10.2**
**Hazard Quotient Summary for PMJM Receptors**

| ECOPC | Receptor | BAF | EPC | Hazard Quotients (HQs) | |
|---|---|---|---|---|---|
| | | | | Based on Default TRVs | Based on Alternate TRVs (Uncertainty Analysis) |
| Antimony | Patch 19 | Default | UCL | NOAEL = 7<br>LOAEL = 0.7 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 20 | Default | UCL | NOAEL = 19<br>LOAEL = 2 | NOAEL = 0.03 |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 21 | Default | UCL | NOAEL = 6<br>LOAEL = 0.6 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| Chromium | Patch 19 | Default | UCL | *Chromium VI*<br>*NOAEL = 1*<br>*LOAEL = 0.3*<br>*Chromium III*<br>*NOAEL = 0.001* | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 20 | Default | UCL | *Chromium VI*<br>*NOAEL = 0.9*<br>*LOAEL = 0.2*<br>*Chromium III*<br>*NOAEL = 0.001* | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 21 | Default | UCL | *Chromium VI*<br>*NOAEL = 1*<br>*LOAEL = 0.3*<br>*Chromium III*<br>*NOAEL = 0.001* | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| Copper | Patch 20 | Default | UCL | NOAEL = 0.7<br>LOAEL = 0.003 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| Manganese | Patch 19 | Default | UCL | NOAEL = 1<br>LOAEL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 20 | Default | UCL | NOAEL = 1<br>LOAEL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 21 | Default | UCL | NOAEL = 2<br>LOAEL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |

**Table 10.2**

**Hazard Quotient Summary for PMJM Receptors**

| | | | | | |
|---|---|---|---|---|---|
| Molybdenum | Patch 20 | Default | UCL | NOAEL = 1<br>LOAEL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 21 | Default | UCL | NOAEL = 1<br>LOAEL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| Nickel | Patch 19 | Default | UCL | NOAEL = 30<br>LOAEL = 3 | NOAEL = 0.1 |
| | | Alternate (Uncertainty Analysis) | UCL | NOAEL = 8<br>LOAEL = 0.8 | NOAEL = 0.03 |
| | Patch 20 | Default | UCL | NOAEL = 31<br>LOAEL = 3 | NOAEL = 0.1 |
| | | Alternate (Uncertainty Analysis) | UCL | NOAEL = 8<br>LOAEL = 0.8 | NOAEL = 0.03 |
| | Patch 21 | Default | UCL | NOAEL = 31<br>LOAEL = 3 | NOAEL = 0.1 |
| | | Alternate (Uncertainty Analysis) | UCL | NOAEL = 8<br>LOAEL = 0.8 | NOAEL = 0.03 |
| Tin | Patch 19 | Default | UCL | NOAEL = 6<br>LOAEL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 21 | Default | UCL | NOAEL = 8<br>LOAEL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| Vanadium | Patch 19 | Default | UCL | NOAEL = 2<br>LOAEL = 0.2 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 20 | Default | UCL | NOAEL = 2<br>LOAEL = 0.2 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 21 | Default | UCL | NOAEL = 2<br>LOAEL = 0.2 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| Zinc | Patch 19 | Default | UCL | NOAEL = 3<br>LOAEL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 20 | Default | UCL | NOAEL = 3<br>LOAEL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| | Patch 21 | Default | UCL | NOAEL = 2<br>LOAEL = 0.1 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |
| Total PCBs | Patch 20 | Default | UCL | NOAEL = 1<br>LOAEL = 0.5 | Not Calculated |
| | | Alternate (Uncertainty Analysis) | UCL | Not Calculated | Not Calculated |

Shaded cells represent default HQ calculations based on the exposure and toxicity models specifically identified in the CRA Methodology.

All HQ calculations are provided in Attachment 4.

Discussion of the chemical-specific uncertainties are provided in Attachment 5.

Table 10.3
Tier 2 Grid Cell Hazard Quotients for Surface Soil in UWOEU

| ECOPC | Most Sensitive Receptor | Number of Grid Cells | Percent of Tier 2 Grid Cell Mean Concentrations: NOAEL TRV HQ < 1 | NOAEL TRV HQ > 1 <5 | NOAEL TRV HQ > 5 <10 | NOAEL TRV HQ > 10 | Threshold TRV HQ < 1 | Threshold TRV HQ > 1 <5 | Threshold TRV HQ > 5 <10 | Threshold TRV HQ > 10 | LOAEL TRV HQ < 1 | LOAEL TRV HQ > 1 <5 | LOAEL TRV HQ > 5 <10 | LOAEL TRV HQ > 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Inorganics*** | | | | | | | | | | | | | | |
| Antimony | Deer Mouse - Insectivore | 26 | 50 | 15 | 31 | 4 | N/A | N/A | N/A | N/A | 100 | 0 | 0 | 0 |
| Copper | Mourning Dove - Insectivore | 26 | 4 | 96 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 |
| Nickel | Deer Mouse - Insectivore | 26 | 0 | 0 | 0 | 100 | N/A | N/A | N/A | N/A | 0 | 96 | 4 | 0 |
| Tin | Mourning Dove - Insectivore | 26 | 58 | 35 | 4 | 4 | N/A | N/A | N/A | N/A | 100 | 0 | 0 | 0 |
| Vanadium | Deer Mouse - Insectivore | 26 | 27 | 73 | 0 | 0 | N/A | N/A | N/A | N/A | 100 | 0 | 0 | 0 |
| ***Organics*** | | | | | | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | Mourning Dove - Insectivore | 12 | 0 | 100 | 0 | 0 | N/A | N/A | N/A | N/A | 100 | 0 | 0 | 0 |
| Di-N-Butylphthalate | Mourning Dove - Insectivore | 12 | 0 | 0 | 0 | 100 | N/A | N/A | N/A | N/A | 0 | 100 | 0 | 0 |
| Dioxin (Total) | Deer Mouse - Insectivore | 1 | 0 | 100 | 0 | 0 | N/A | N/A | N/A | N/A | 100 | 0 | 0 | 0 |
| Total PCBs | Mourning Dove - Insectivore | 11 | 73 | 27 | 0 | 0 | N/A | N/A | N/A | N/A | 100 | 0 | 0 | 0 |

N/A = No value available
The limiting receptor is chosen as the receptor with the lowest ESL.
Default exposure model and TRVs used.

**Table 11.1**
**Summary of Risk Characterization Results for the UWOEU**

| Analyte | Ecological Receptors | Result of Risk Characterization | Risk Description Conclusion |
|---|---|---|---|
| **Surface Soil Non-PMJM Receptors** | | | |
| Antimony | Terrestrial plants | Tier 1 EPC HQs = 1.<br>Tier 2 EPC HQs = 1. | Low Risk |
| | Terrestrial invertebrate | Not an ECOPC. | Not an ECOPC |
| | American kestrel | Not an ECOPC.[a] | ECOPC of Uncertain Risk |
| | Mourning dove (herbivore) | Not an ECOPC.[a] | ECOPC of Uncertain Risk |
| | Mourning dove (insectivore) | Not an ECOPC.[a] | ECOPC of Uncertain Risk |
| | Deer mouse (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Deer mouse (Insectivore) | NOAEL HQs > 1 for default exposure scenarios.<br>LOAEL HQs < 1 for default exposure scenarios. | Low Risk |
| | Prairie dog | Not an ECOPC. | Not an ECOPC |
| | Coyote (carnivore) | Not an ECOPC. | Not an ECOPC |
| | Coyote (generalist) | Not an ECOPC. | Not an ECOPC |
| | Coyote (insectivore) | NOAEL HQs > 1 for default exposure scenarios (HQ = 2)<br>LOAEL HQs < 1 for default exposure scenarios. | Low Risk |
| | Mule Deer | Not an ECOPC. | Not an ECOPC |
| Copper | Terrestrial plants | Not an ECOPC. | Not an ECOPC |
| | Terrestrial invertebrate | Not an ECOPC. | Not an ECOPC |
| | American kestrel | Not an ECOPC. | Not an ECOPC |
| | Mourning dove (herbivore) | Tier 1 NOAEL HQ > 1 using default exposure scenarios (HQ = 2)<br>Tier 2 NOAEL HQ < 1 using default exposure scenarios<br>LOAEL and threshold HQs < 1 using default exposure scenarios. | Low Risk |
| | Mourning dove (insectivore) | Tier 1 UTL NOAEL HQ > 1 using default exposure scenarios (HQ =2)<br>Tier 2 NOAEL HQs =1 using default exposure scenarios<br>LOAEL and threshold HQs < 1 using default exposure scenarios. | Low Risk |
| | Deer mouse (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Deer mouse (Insectivore) | Not an ECOPC. | Not an ECOPC |
| | Prairie dog | Not an ECOPC. | Not an ECOPC |
| | Coyote (carnivore) | Not an ECOPC. | Not an ECOPC |
| | Coyote (generalist) | Not an ECOPC. | Not an ECOPC |
| | Coyote (insectivore) | Not an ECOPC. | Not an ECOPC |
| | Mule Deer | Not an ECOPC. | Not an ECOPC |
| Nickel | Terrestrial plants | Not an ECOPC. | Not an ECOPC |
| | Terrestrial invertebrate | Not an ECOPC. | Not an ECOPC |
| | American kestrel | Not an ECOPC. | Not an ECOPC |
| | Mourning dove (herbivore) | Not an ECOPC. | Not an ECOPC |

**Table 11.1**
**Summary of Risk Characterization Results for the UWOEU**

| Analyte | Ecological Receptors | Result of Risk Characterization | Risk Description Conclusion |
|---|---|---|---|
| **Surface Soil Non-PMJM Receptors** | | | |
| | Mourning dove (insectivore) | NOAEL HQs > 1 for default exposure scenarios.<br>Threshold HQs > 1 for default exposure scenarios.<br>LOAEL HQs < 1 for default exposure scenarios. | Low Risk |
| | Deer mouse (herbivore) | NOAEL HQs < = 1 for default exposure scenarios and TRVs.<br>LOAEL HQs < 1 for default exposure scenarios and TRVs. | Low Risk |
| Nickel | Deer mouse (Insectivore) | NOAEL and LOAEL HQs > 1 for default exposure scenarios and TRVs.<br>All HQs < 1 for default exposure scenarios and alternative TRVs.<br>NOAEL HQs > 1 for alternative exposure scenarios and default TRVs.<br>LOAEL HQs < or = 1 for alternative exposure scenarios and default TRVs.<br>All HQs < 1 for alternative exposure scenarios and alternative TRVs. | Low to Moderate Risk |
| | Prairie dog | Not an ECOPC. | Not an ECOPC |
| | Coyote (carnivore) | Not an ECOPC. | Not an ECOPC |
| | Coyote (generalist) | NOAEL HQs > 1 for default exposure scenarios.<br>LOAEL HQs < 1 for default exposure scenarios. | Low Risk |
| | Coyote (insectivore) | NOAEL HQs > 1 for default exposure scenarios.<br>LOAEL HQs < or = 1 for default exposure scenarios. | Low Risk |
| | Mule Deer | Not an ECOPC. | Not an ECOPC |
| Silver | Terrestrial plants | Tier 1 HQ > 1 (HQ = 2)<br>Tier 2 HQ < 1. | Low Risk |
| | Terrestrial invertebrate | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | American kestrel | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | Mourning dove (herbivore) | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | Mourning dove (insectivore) | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | Deer mouse (herbivore) | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | Deer mouse (Insectivore) | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | Prairie dog | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | Coyote (carnivore) | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | Coyote (generalist) | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | Coyote (insectivore) | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | Mule Deer | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| Tin | Terrestrial plants | Not an ECOPC. | Not an ECOPC |
| | Terrestrial invertebrate | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | American kestrel | NOAEL HQs < or = 1 for default exposure scenarios.<br>LOAEL HQs < 1 for default exposure scenarios. | Low Risk |

**Table 11.1**
**Summary of Risk Characterization Results for the UWOEU**

| Analyte | Ecological Receptors | Result of Risk Characterization | Risk Description Conclusion |
|---|---|---|---|
| **Surface Soil Non-PMJM Receptors** | | | |
| | Mourning dove (herbivore) | NOAEL HQs < or = 1 for default exposure scenarios. LOAEL HQs < 1 for default exposure scenarios. | Low Risk |
| | Mourning dove (insectivore) | NOAEL HQs > 1 for default exposure scenarios. LOAEL HQs < 1 for all default exposure scenarios. | Low Risk |
| | Deer mouse (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Deer mouse (Insectivore) | NOAEL HQs > 1 for default exposure scenarios. LOAEL HQs < 1 for all default exposure scenarios. | Low Risk |
| | Prairie dog | Not an ECOPC. | Not an ECOPC |
| | Coyote (carnivore) | Not an ECOPC. | Not an ECOPC |
| | Coyote (generalist) | Not an ECOPC. | Not an ECOPC |
| | Coyote (insectivore) | Not an ECOPC. | Not an ECOPC |
| | Mule Deer | Not an ECOPC. | Not an ECOPC |
| Uranium | Terrestrial plants | Tier 1 HQ > 1. Tier 2 HQ = 1. Alternative Tier 1 HQ > 1. Alternative Tier 2 HQ < 1. | Low Risk |
| | Terrestrial invertebrate | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | American kestrel | Not an ECOPC. | Not an ECOPC |
| | Mourning dove (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Mourning dove (insectivore) | Not an ECOPC. | Not an ECOPC |
| Uranium | Deer mouse (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Deer mouse (Insectivore) | Not an ECOPC. | Not an ECOPC |
| | Prairie dog | Not an ECOPC. | Not an ECOPC |
| | Coyote (carnivore) | Not an ECOPC. | Not an ECOPC |
| | Coyote (generalist) | Not an ECOPC. | Not an ECOPC |
| | Coyote (insectivore) | Not an ECOPC. | Not an ECOPC |
| | Mule Deer | Not an ECOPC. | Not an ECOPC |
| Vanadium | Terrestrial plants | Tier 1 HQ > 1. Tier 2 HQ > 1. Alternative Tier 1 HQ = 1. Alternative Tier 2 HQ < 1. | Low Risk |
| | Terrestrial invertebrate | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | American kestrel | Not an ECOPC. | Not an ECOPC |
| | Mourning dove (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Mourning dove (insectivore) | Not an ECOPC. | Not an ECOPC |
| | Deer mouse (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Deer mouse (Insectivore) | Tier 1 NOAEL HQ > 1 (HQ = 2) for default exposure scenarios. Tier 2 NOAEL HQ = 1 for default exposure scenarios. LOAEL HQs < 1 for default exposure scenarios. | Low Risk |
| | Prairie dog | Not an ECOPC. | Not an ECOPC |
| | Coyote (carnivore) | Not an ECOPC. | Not an ECOPC |
| | Coyote (generalist) | Not an ECOPC. | Not an ECOPC |
| | Coyote (insectivore) | Not an ECOPC. | Not an ECOPC |
| | Mule Deer | Not an ECOPC. | Not an ECOPC |

**Table 11.1**

**Summary of Risk Characterization Results for the UWOEU**

| Analyte | Ecological Receptors | Result of Risk Characterization | Risk Description Conclusions |
|---|---|---|---|
| **Surface Soil Non-PMJM Receptors** | | | |
| Bis(2-ethylhexyl)phthalate | Terrestrial plants | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | Terrestrial invertebrate | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | American kestrel | NOAEL HQs < or = 1 for default exposure scenarios. LOAEL HQs < 1 for default exposure scenarios. | Low Risk |
| | Mourning dove (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Mourning dove (insectivore) | NOAEL HQs > 1 for default exposure scenarios. LOAEL HQs < 1 for all default exposure scenarios . | Low Risk |
| | Deer mouse (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Deer mouse (Insectivore) | Not an ECOPC. | Not an ECOPC |
| | Prairie dog | Not an ECOPC. | Not an ECOPC |
| | Coyote (carnivore) | Not an ECOPC. | Not an ECOPC |
| | Coyote (generalist) | Not an ECOPC. | Not an ECOPC |
| | Coyote (insectivore) | Not an ECOPC. | Not an ECOPC |
| | Mule Deer | Not an ECOPC. | Not an ECOPC |
| Di-n-butylphthalate | Terrestrial plants | Not an ECOPC. | Not an ECOPC |
| | Terrestrial invertebrate | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | American kestrel | NOAEL HQs > 1 for default exposure scenarios. LOAEL HQs < = 1 for all default exposure scenarios. | Low Risk |
| | Mourning dove (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Mourning dove (insectivore) | NOAEL HQs > 1 for default exposure scenarios LOAEL HQs > 1 for default exposure scenarios (HQs = 2 or 3). | Low Risk |
| | Deer mouse (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Deer mouse (Insectivore) | Not an ECOPC. | Not an ECOPC |
| | Prairie dog | Not an ECOPC. | Not an ECOPC |
| | Coyote (carnivore) | Not an ECOPC. | Not an ECOPC |
| | Coyote (generalist) | Not an ECOPC. | Not an ECOPC |
| | Coyote (insectivore) | Not an ECOPC. | Not an ECOPC |
| | Mule Deer | Not an ECOPC. | Not an ECOPC |
| Dioxin (Total) | Terrestrial plants | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| Dioxin (Total) | Terrestrial invertebrate | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | American kestrel | Tier 1 NOAEL HQ > 1 (HQ = 2) for default exposure scenario. Tier 1 LOAEL HQ < 1 for default exposure scenario. No Tier 2 NOAEL or LOAEL HQs available. | Low Risk |
| | Mourning dove (herbivore) | Not an ECOPC. | Not an ECOPC |

**Table 11.1**
**Summary of Risk Characterization Results for the UWOEU**

| Analyte | Ecological Receptors | Result of Risk Characterization | Risk Description Conclusion |
|---|---|---|---|
| **Surface Soil Non-PMJM Receptors** | | | |
| | Mourning dove (insectivore) | Tier 1 NOAEL HQ > 1 for default exposure scenario.<br>Tier 1 LOAEL HQ = 1 for default exposure scenario.<br>No Tier 2 NOAEL or LOAEL HQs available. | Low Risk |
| | Deer mouse (herbivore) | Tier 1 NOAEL HQ > 1 (HQ = 2) for default exposure scenario.<br>Tier 1 LOAEL HQ < 1 for default exposure scenario.<br>No Tier 2 NOAEL or LOAEL HQs available. | Low Risk |
| | Deer mouse (Insectivore) | Tier 1 NOAEL HQ > 1 for default exposure scenario.<br>Tier 1 LOAEL HQ > 1 (HQ = 2) for default exposure scenario.<br>No Tier 2 NOAEL or LOAEL HQs available. | Low Risk |
| | Prairie dog | Not an ECOPC. | Not an ECOPC |
| | Coyote (carnivore) | Not an ECOPC. | Not an ECOPC |
| | Coyote (generalist) | Tier 1 NOAEL HQ > 1 (HQ = 2) for default exposure scenario.<br>Tier 1 LOAEL HQ < 1 for default exposure scenario.<br>No Tier 2 NOAEL or LOAEL HQs available. | Low Risk |
| | Coyote (insectivore) | Tier 1 NOAEL HQ > 1 for default exposure scenario.<br>Tier 1 LOAEL HQ < 1 for default exposure scenario.<br>No Tier 2 NOAEL or LOAEL HQs available. | Low Risk |
| | Mule Deer | Not an ECOPC. | Not an ECOPC |
| Total PCBs | Terrestrial plants | Not an ECOPC. | Not an ECOPC |
| | Terrestrial invertebrate | Not an ECOPC[a]. | ECOPC of Uncertain Risk |
| | American kestrel | Tier 1 NOAEL HQ > 1 for default exposure scenarios.<br>Tier 2 NOAEL HQ < 1 for default exposure scenarios.<br>LOAEL HQs < 1 for default exposure scenarios. | Low Risk |
| | Mourning dove (herbivore) | Tier 1 NOAEL HQ > 1 for default exposure scenario.<br>Tier 2 NOAEL HQ = 1 for default exposure scenario.<br>LOAEL HQs < or = 1 for default exposure scenarios. | Low Risk |
| | Mourning dove (insectivore) | Tier 1 NOAEL HQ = 1 for default exposure scenario.<br>Tier 2 NOAEL HQ < 1 for default exposure scenario.<br>LOAEL HQs < 1 for default exposure scenarios. | Low Risk |

**Table 11.1**
**Summary of Risk Characterization Results for the UWOEU**

| Analyte | Ecological Receptors | Result of Risk Characterization | Risk Description Conclusion |
|---|---|---|---|
| **Surface Soil Non-PMJM Receptors** | | | |
| | Deer mouse (herbivore) | Not an ECOPC. | Not an ECOPC |
| | Deer mouse (Insectivore) | Not an ECOPC. | Not an ECOPC |
| | Prairie dog | Not an ECOPC. | Not an ECOPC |
| | Coyote (carnivore) | Not an ECOPC. | Not an ECOPC |
| | Coyote (generalist) | Not an ECOPC. | Not an ECOPC |
| | Coyote (insectivore) | Not an ECOPC. | Not an ECOPC |
| | Mule Deer | Not an ECOPC. | Not an ECOPC |
| **Surface Soil - PMJM Receptors** | | | |
| Antimony | Patch 19 | NOAEL HQ > 1 for default exposure scenario. LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| | Patch 20 | NOAEL HQ > 1 for default exposure scenario. LOAEL HQ > 1 for default exposure scenario HQ = 2). Alternative NOAEL < 1 for default exposure scenario with alternative TRV. | Low Risk |
| | Patch 21 | NOAEL HQ > 1 for default exposure scenario. LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| Chromium | Patch 19 | Chromium VI NOAEL HQ = 1 for default exposure scenario. Chromium III NOAEL HQ < 1 for default exposure scenario. Chromium VI LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| | Patch 20 | Chromium VI NOAEL HQ < 1 for default exposure scenario. Chromium III NOAEL HQ < 1 for default exposure scenario. Chromium VI LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| | Patch 21 | Chromium VI NOAEL HQ = 1 for default exposure scenario. Chromium III NOAEL HQ < 1 for default exposure scenario. Chromium VI LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| Copper | Patch 11 | NOAEL HQ < 1 for default exposure scenario. LOAEL HQ < 1 for default exposure scenarios | Low Risk |
| Manganese | Patch 19 | NOAEL HQ = 1 for default exposure scenario. LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| | Patch 20 | NOAEL HQ = 1 for default exposure scenario. LOAEL HQ < 1 for default exposure scenario. | Low Risk |

Table 11.1
**Summary of Risk Characterization Results for the UWOEU**

| Analyte | Ecological Receptors | Result of Risk Characterization | Risk Description Conclusion |
|---|---|---|---|
| **Surface Soil Non-PMJM Receptors** | | | |
| | Patch 21 | NOAEL HQ > 1 for default exposure scenario (HQ = 2).<br>LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| Molybdenum | Patch 20 | NOAEL HQ = 1 for default exposure scenario.<br>LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| | Patch 21 | NOAEL HQ = 1 for default exposure scenario.<br>LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| Nickel | Patch 19 | NOAEL HQ > 1 for default exposure scenario.<br>LOAEL HQ > 1 for default exposure scenario (HQ = 3).<br>Alternative NOAEL HQ > 1 using alternative exposure scenario.<br>Alternative LOAEL HQ < 1 using alternative exposure scenario.<br>NOAEL HQ < 1 using default exposure scenario with alternative TRV. | Low Risk |
| Nickel | Patch 20 | NOAEL HQ > 1 for default exposure scenario.<br>LOAEL HQ > 1 for default exposure scenario (HQ = 3).<br>Alternative NOAEL HQ > 1 using alternative exposure scenario.<br>Alternative LOAEL HQ < 1 using alternative exposure scenario.<br>NOAEL HQ < 1 using default exposure scenario with alternative TRV. | Low Risk |
| | Patch 21 | NOAEL HQ > 1 for default exposure scenario.<br>LOAEL HQ > 1 for default exposure scenario (HQ = 3).<br>Alternative NOAEL HQ > 1 using alternative exposure scenario.<br>Alternative LOAEL HQ < 1 using alternative exposure scenario.<br>NOAEL HQ < 1 using default exposure scenario with alternative TRV. | Low Risk |
| Tin | Patch 19 | NOAEL HQ > 1 for default exposure scenario.<br>LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| | Patch 21 | NOAEL HQ > 1 for default exposure scenario.<br>LOAEL HQ < 1 for default exposure scenario. | Low Risk |

**Table 11.1**
**Summary of Risk Characterization Results for the UWOEU**

| Analyte | Ecological Receptors | Result of Risk Characterization | Risk Description Conclusion |
|---|---|---|---|
| **Surface Soil Non-PMJM Receptors** | | | |
| Vanadium | Patch 19 | NOAEL HQ > 1 for default exposure scenario (HQ = 2). LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| | Patch 20 | NOAEL HQ > 1 for default exposure scenario (HQ = 2). LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| | Patch 21 | NOAEL HQ > 1 for default exposure scenario (HQ = 3). LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| Zinc | Patch 19 | NOAEL HQ > 1 for default exposure scenario (HQ = 3). LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| | Patch 20 | NOAEL HQ > 1 for default exposure scenario (HQ = 2). LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| | Patch 21 | NOAEL HQ > 1 for default exposure scenario (HQ = 2). LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| Total PCBs | Patch 20 | NOAEL HQ = 1 for default exposure scenario. LOAEL HQ < 1 for default exposure scenario. | Low Risk |
| **Subsurface Soil** | | | |
| None | Prairie dog | No ECOPCs. | No ECOPCs |

[a]ESL was not available. Analyte evaluated in Section 10.0.

# FIGURES

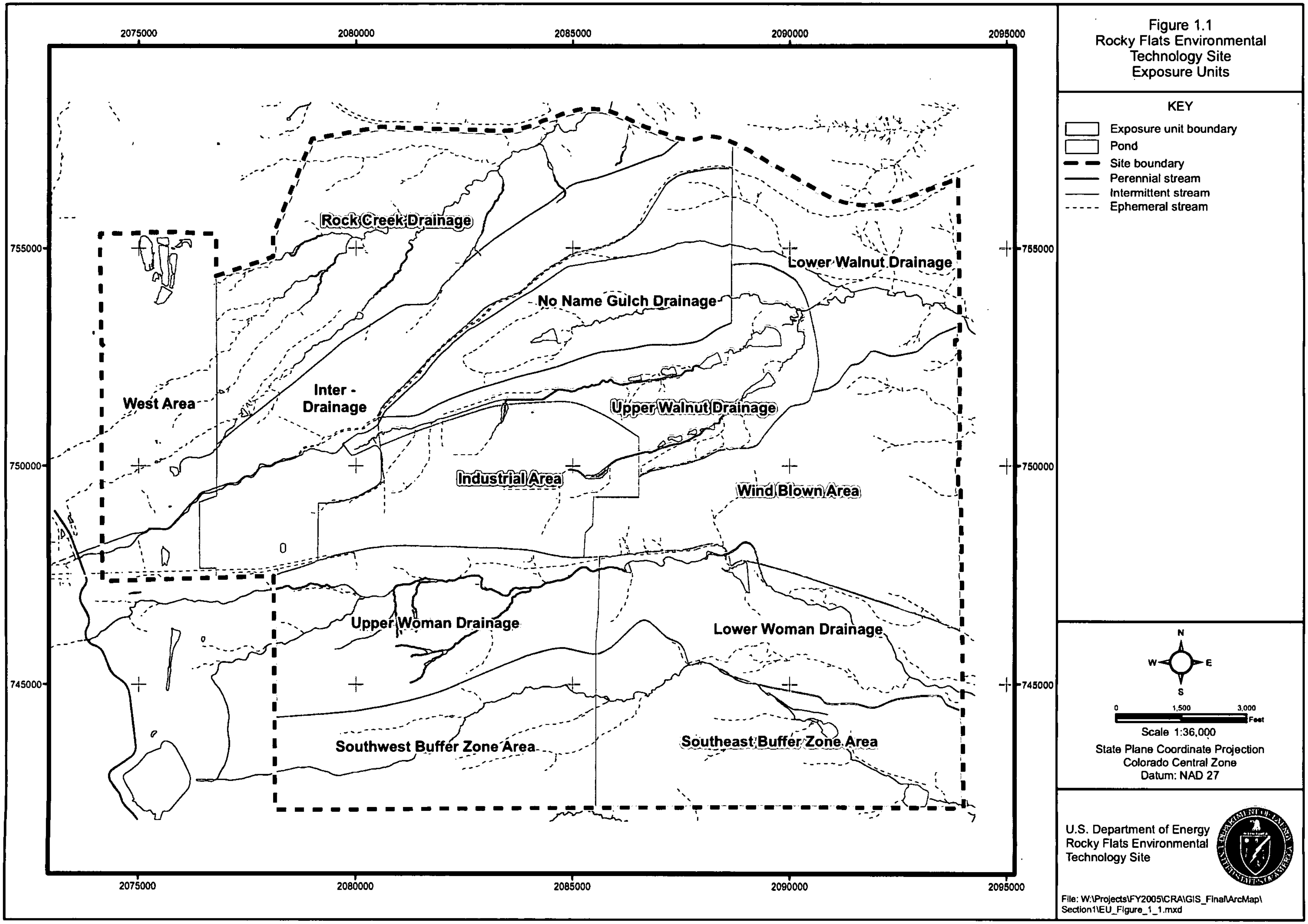



Figure 1.1
Rocky Flats Environmental
Technology Site
Exposure Units

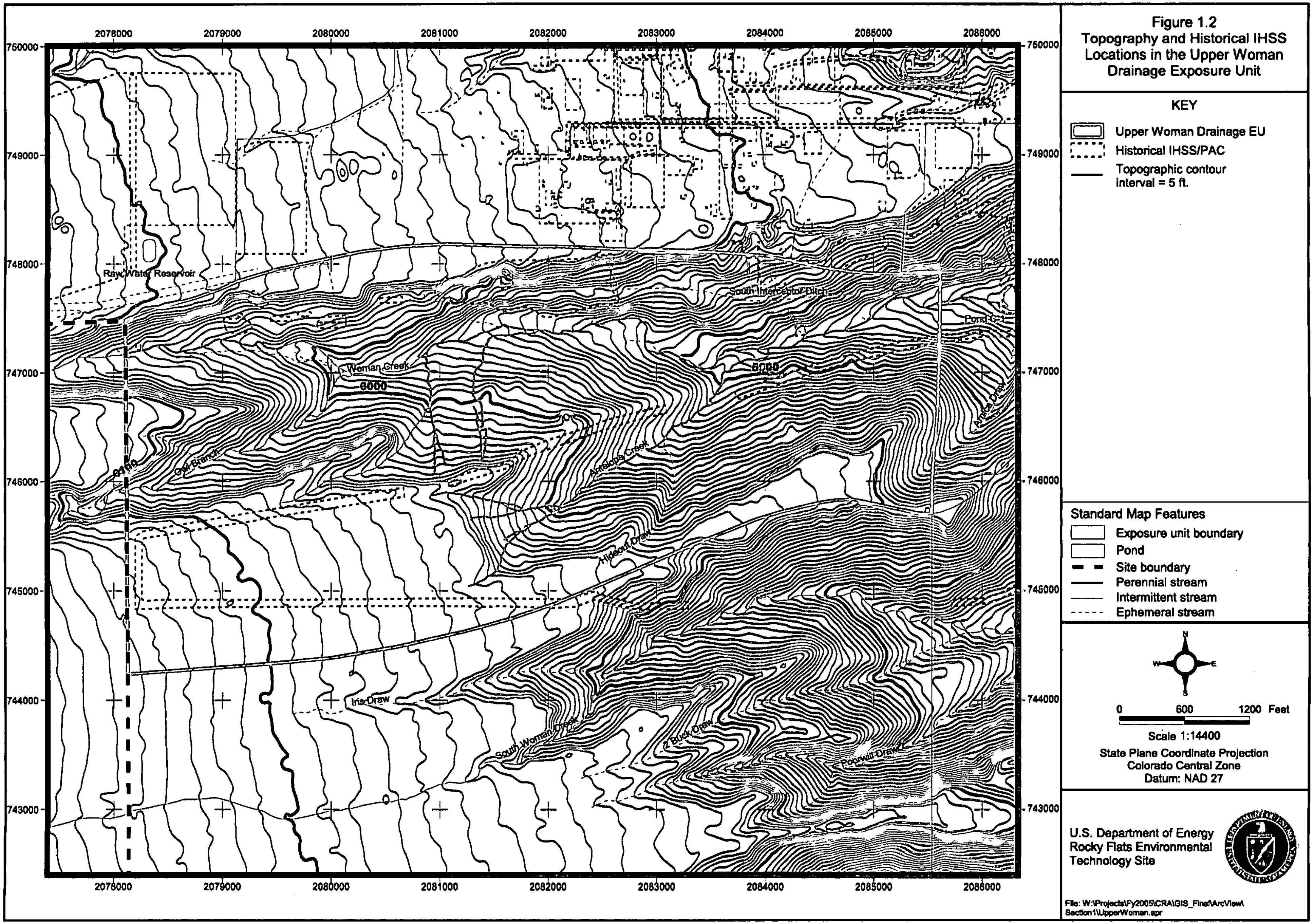



Figure 1.2
Topography and Historical IHSS Locations in the Upper Woman Drainage Exposure Unit

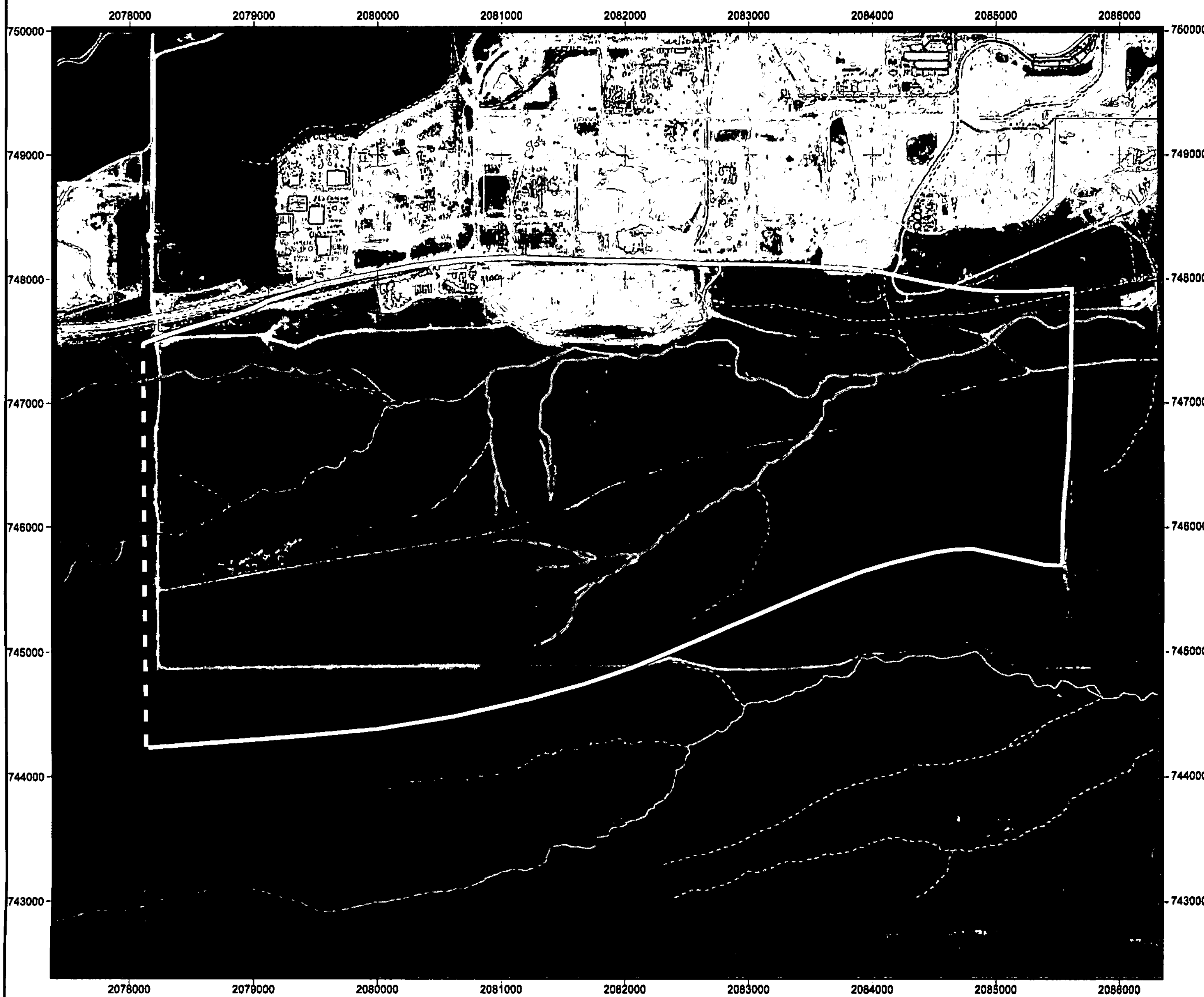



Figure 1.3
Aerial Photograph of the Upper Woman Drainage Exposure Unit
July 2005

KEY

Upper Woman Drainage EU

Standard Map Features

Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWoman.apr

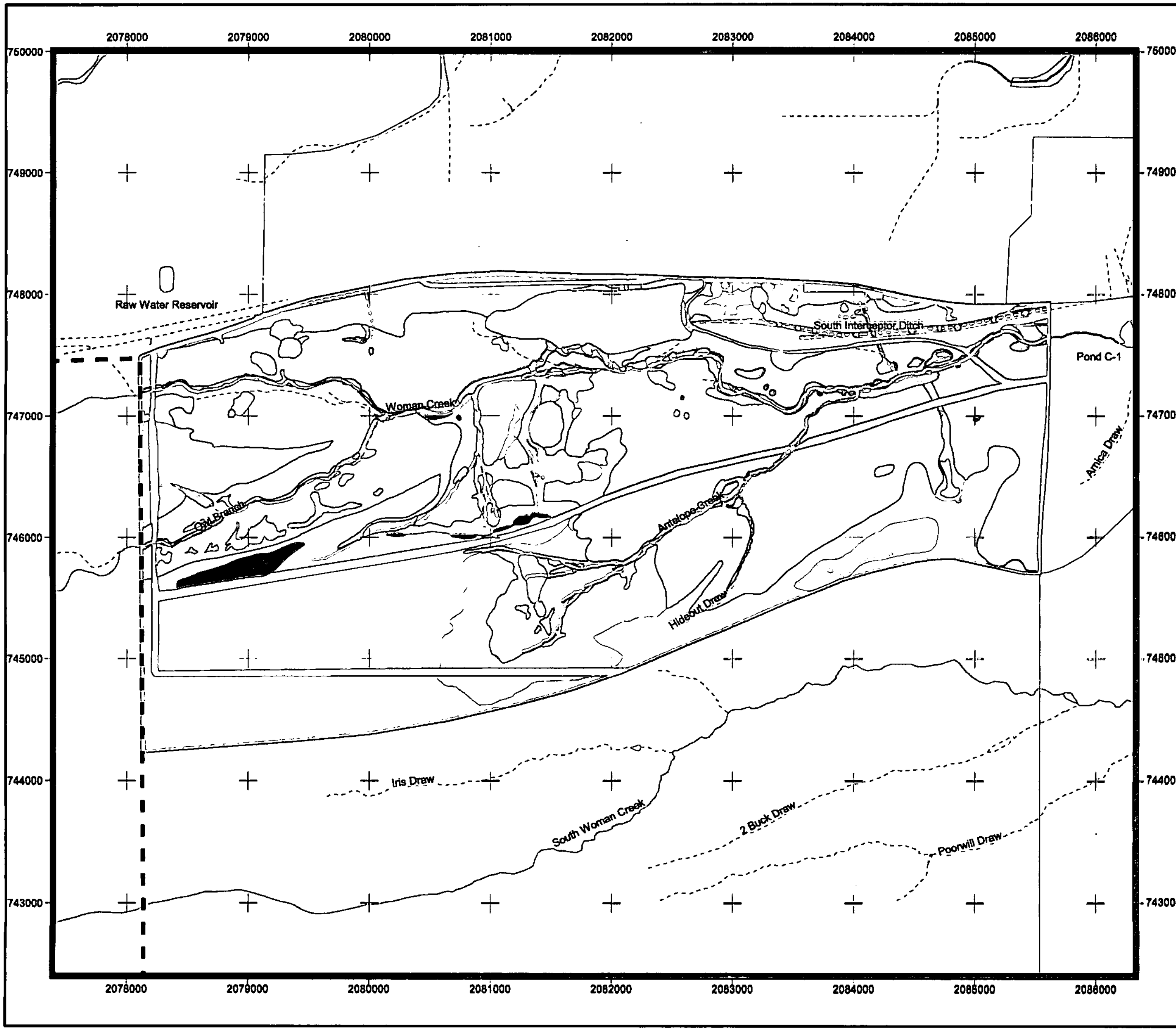



**Figure 1.4**
**Vegetation in the Upper Woman Drainage Exposure Unit**

**KEY**

Upper Woman Drainage EU

Vegetation, 2005

- Annual grass/forb community
- Disturbed areas
- Disturbed and revegetated areas
- Leadplant riparian shrubland
- Mesic mixed grassland
- Mudflats
- Open water
- Ponderosa woodland
- Reclaimed mixed grassland
- Riparian woodland
- Riprap, rock, and gravel piles
- Savannah shrubland
- Short grassland
- Short marsh
- Short upland shrubland
- Tall marsh
- Tall upland shrubland
- Tree plantings
- Wet meadow/marsh ecotone
- Willow riparian shrubland
- Xeric needle and thread grass prairie
- Xeric tallgrass prairie

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWoman.apr

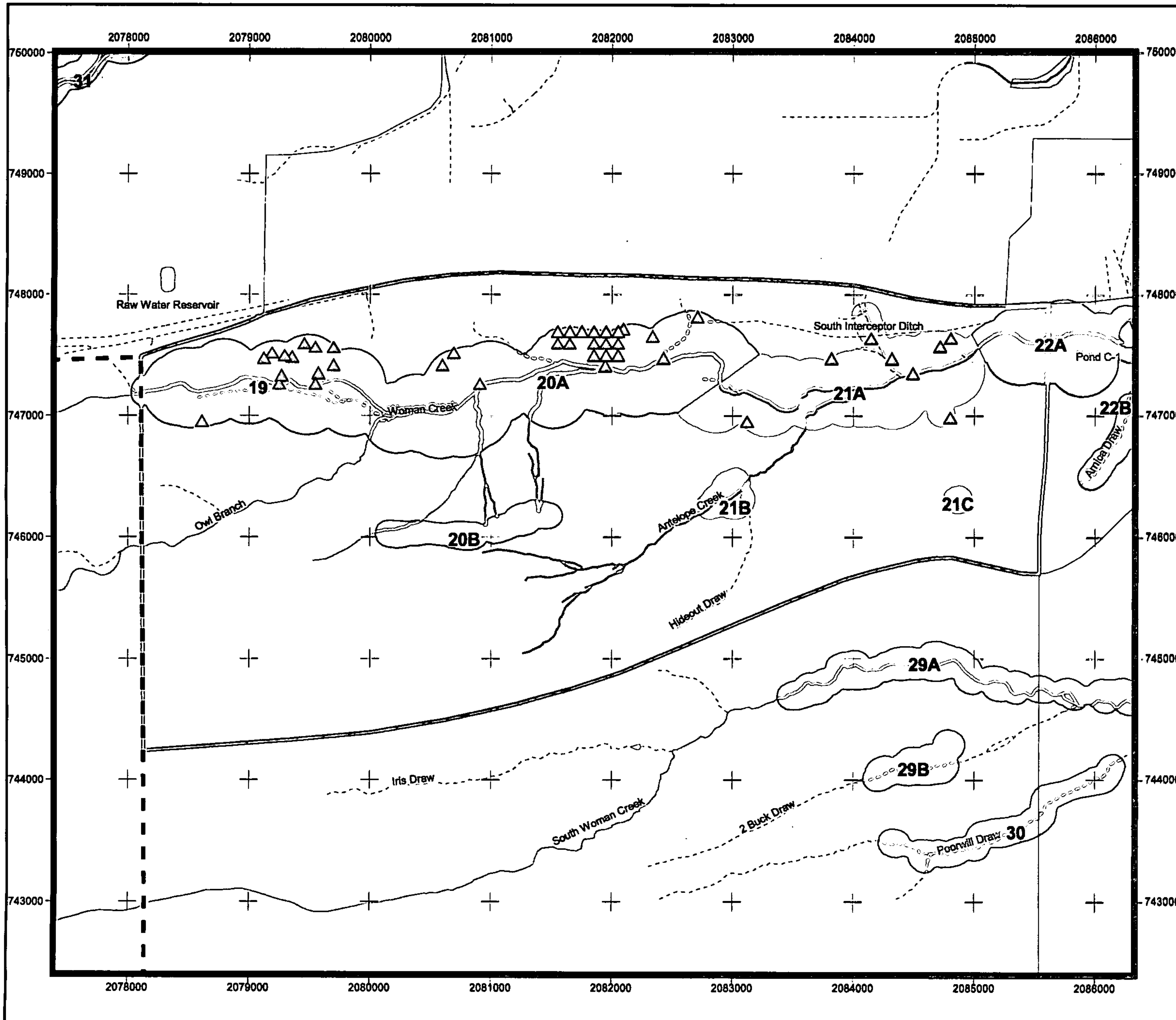



**Figure 1.5**
**Preble's Meadow Jumping Mouse Habitat and Surface Soil Sample Locations in the Upper Woman Drainage Exposure Unit**

**KEY**

- △ Surface soil sample location
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

Note: Not all analyte groups were analyzed at every sample location.

**Standard Map Features**

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

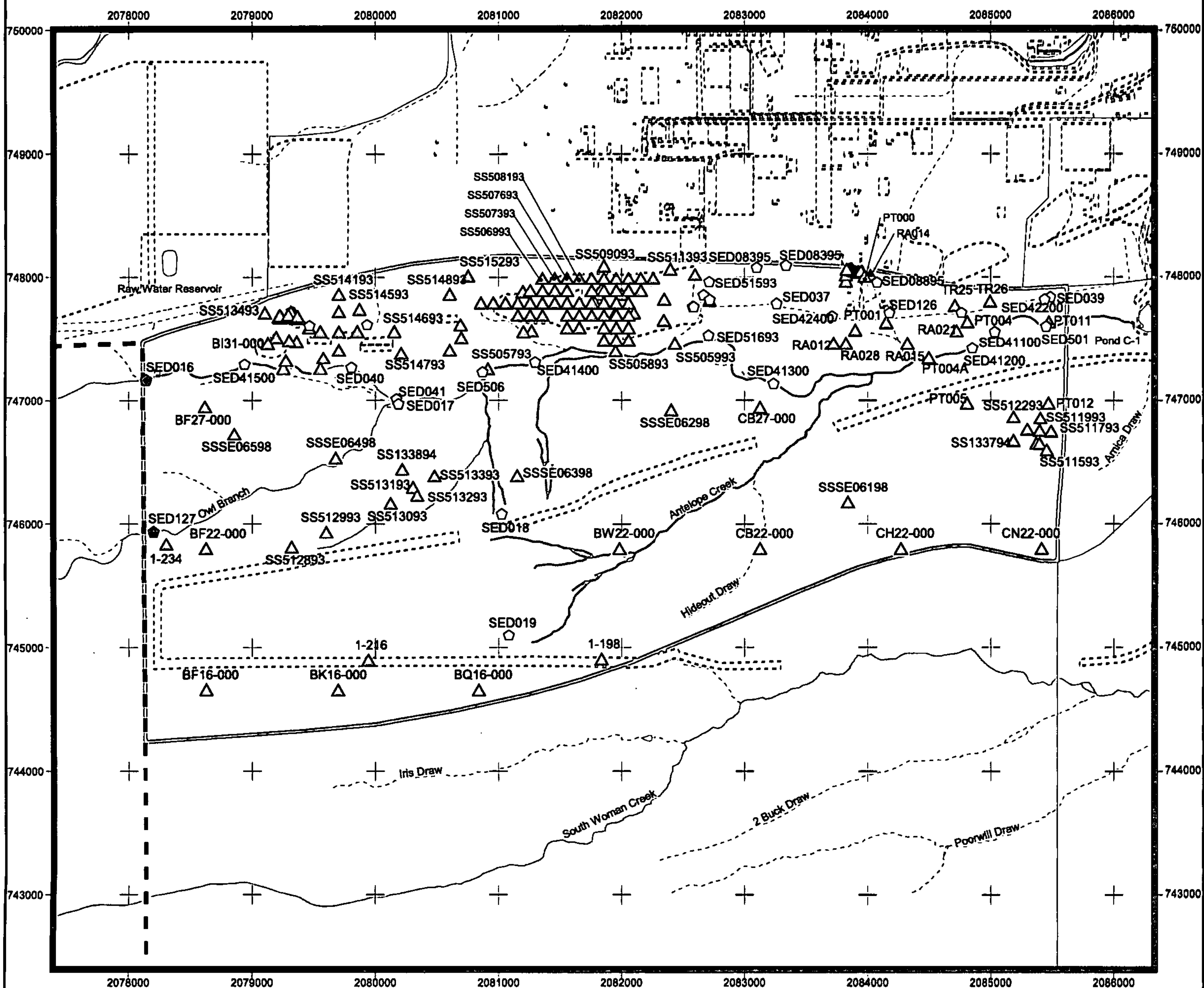
0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWoman.apr




## Figure 1.6
## Upper Woman Drainage Exposure Unit Surface Soil and Surface Sediment Sample Locations

### KEY

Sample location
- Surface sediment sample location
- Surface soil sample location

(Background locations shown in red)
- Surface sediment sample location
- Surface soil sample location
- Upper Woman Drainage EU
- Historical IHSS/PAC

### Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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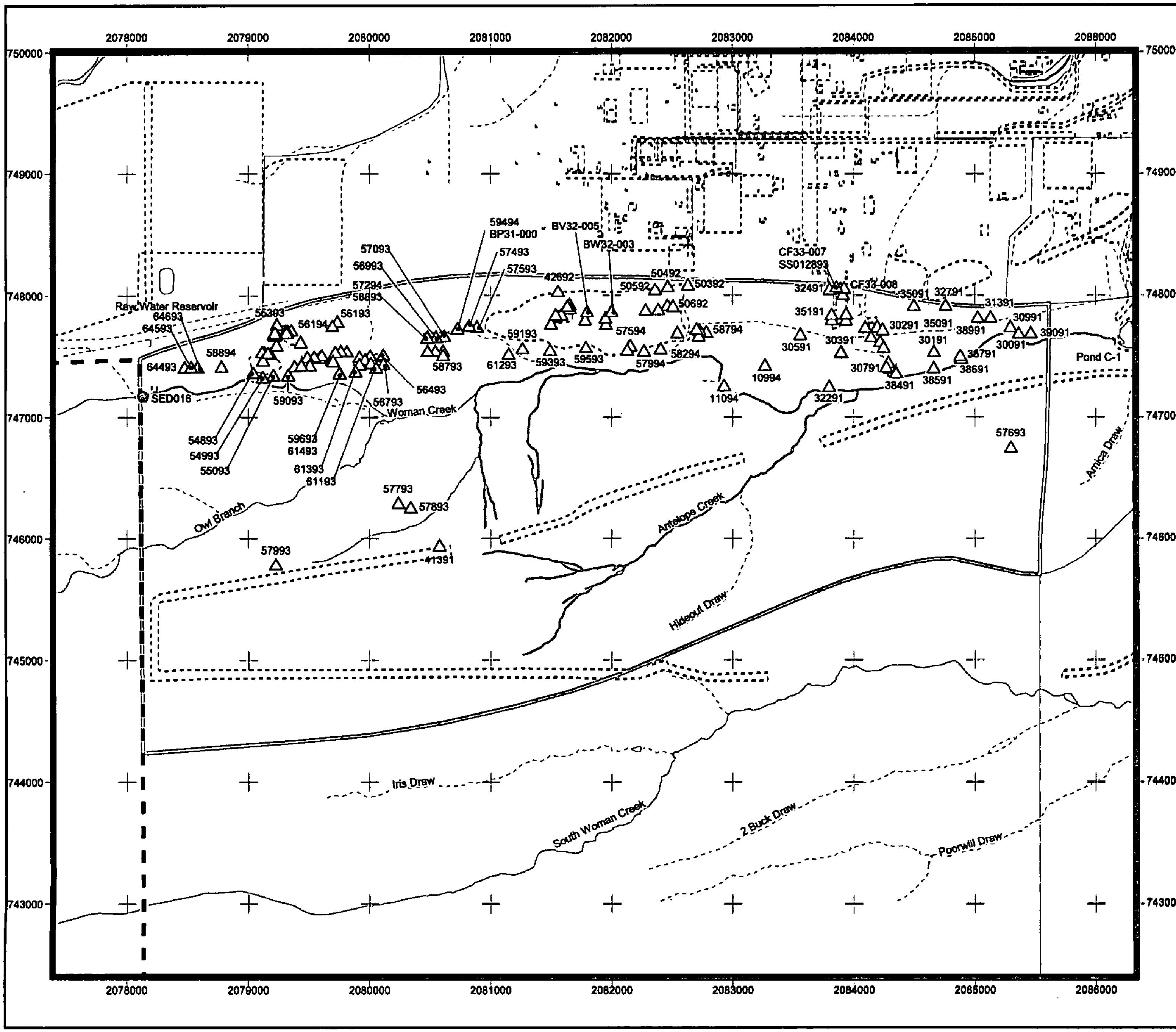
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWoman.apr




# Figure 1.7
## Upper Woman Drainage Exposure Unit Subsurface Soil and Subsurface Sediment Sample Locations

### KEY

Sample location
- Subsurface sediment sample location
- Subsurface soil sample location

(Background locations shown in red)
- Subsurface sediment sample location
- Subsurface soil sample location
- Upper Woman Drainage EU
- Historical IHSS/PAC

### Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N S E W

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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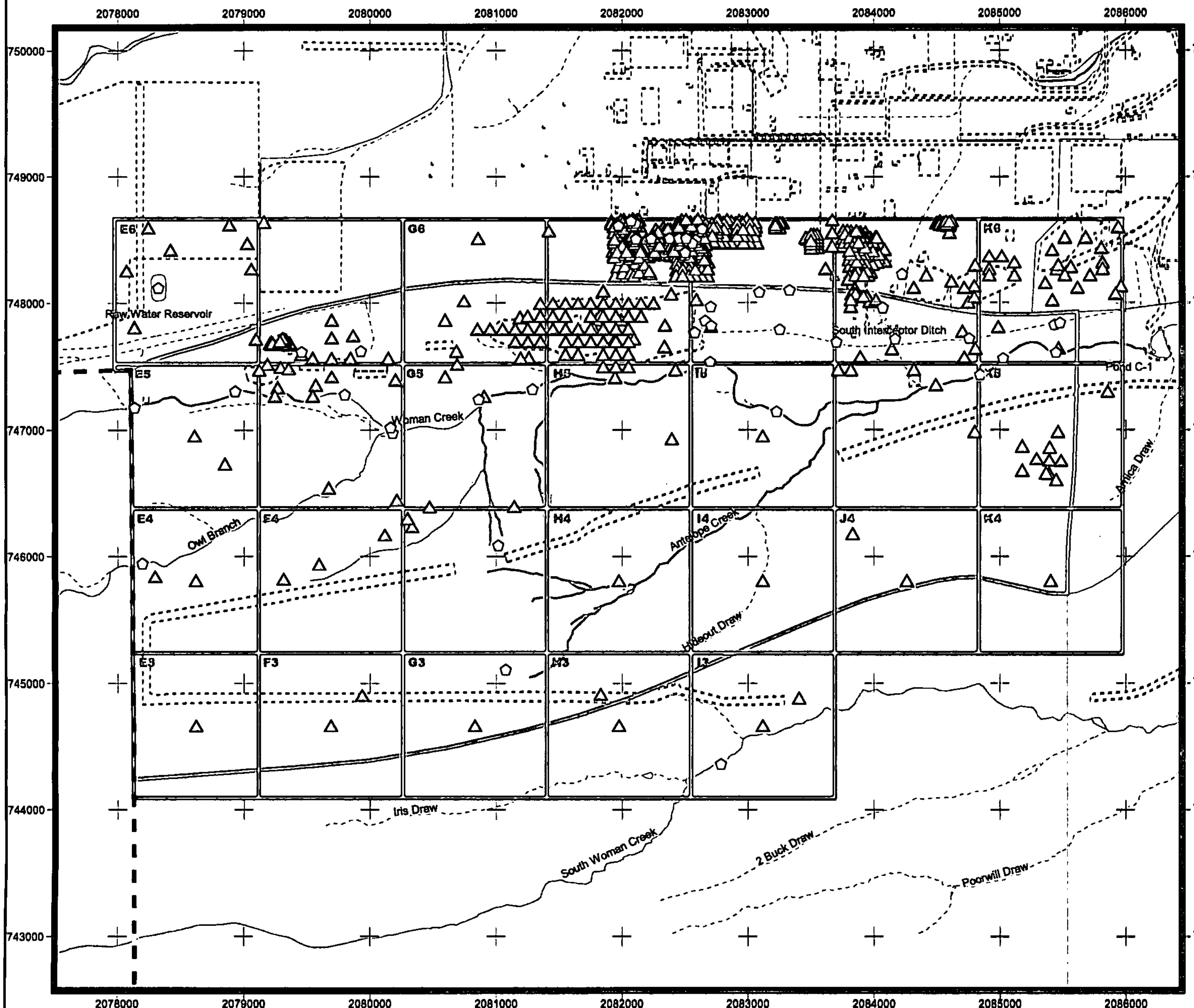


Figure 3.1
Tier 2 EPC 30-acre Grids
with Surface Soil and Surface
Sediment Sample Locations

KEY

- Surface sediment sample location
- Surface soil sample location
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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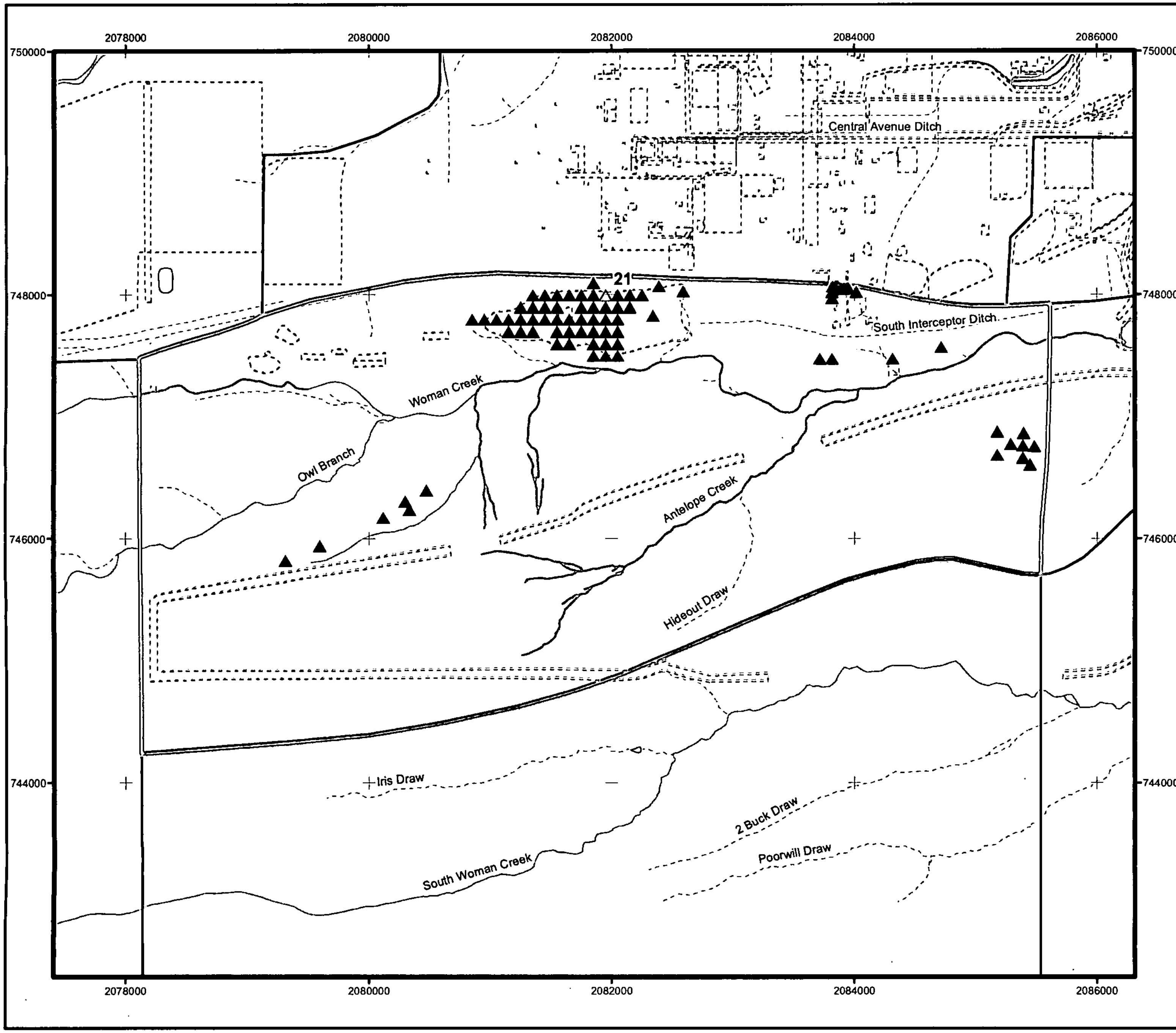
Figure 7.1
Upper Woman Drainage EU
Surface Soil Results
for 4,4-DDT




KEY

Sample location
- △ Detect
- ▲ Nondetect
- Upper Woman Drainage EU
- Historical IHSS/PAC

CRA Methodology ESL = 1.203761 ug/kg

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 600 1,200 Feet

Scale 1:14,400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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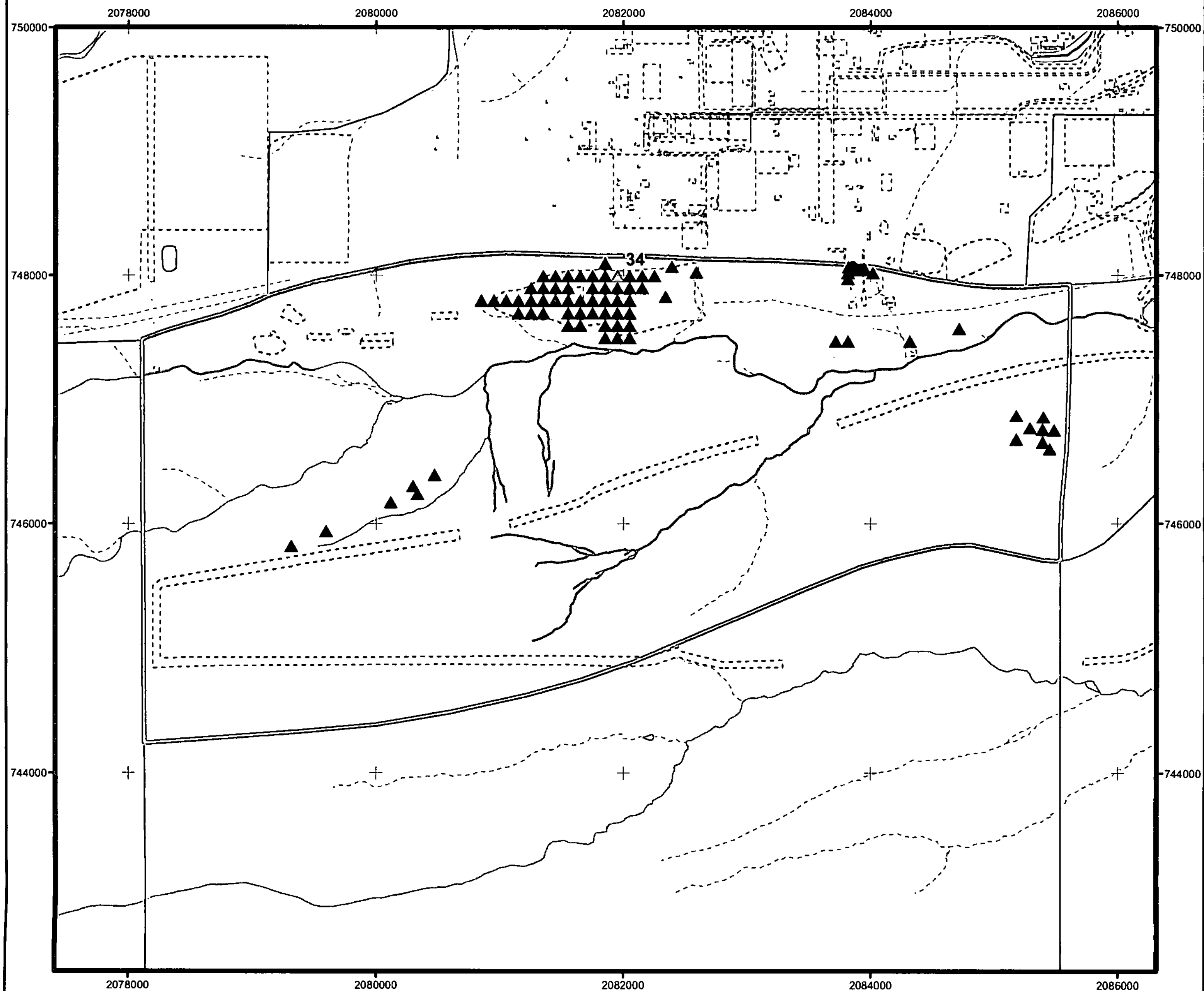
Figure 7.2
Upper Woman Drainage EU
Surface Soil Results
for Dieldrin




KEY

Sample location
- △ Detect
- ▲ Nondetect
- Upper Woman Drainage EU
- Historical IHSS/PAC

CRA Methodology ESL = 7.4 ug/kg

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 600 1,200
Feet

Scale 1:14,400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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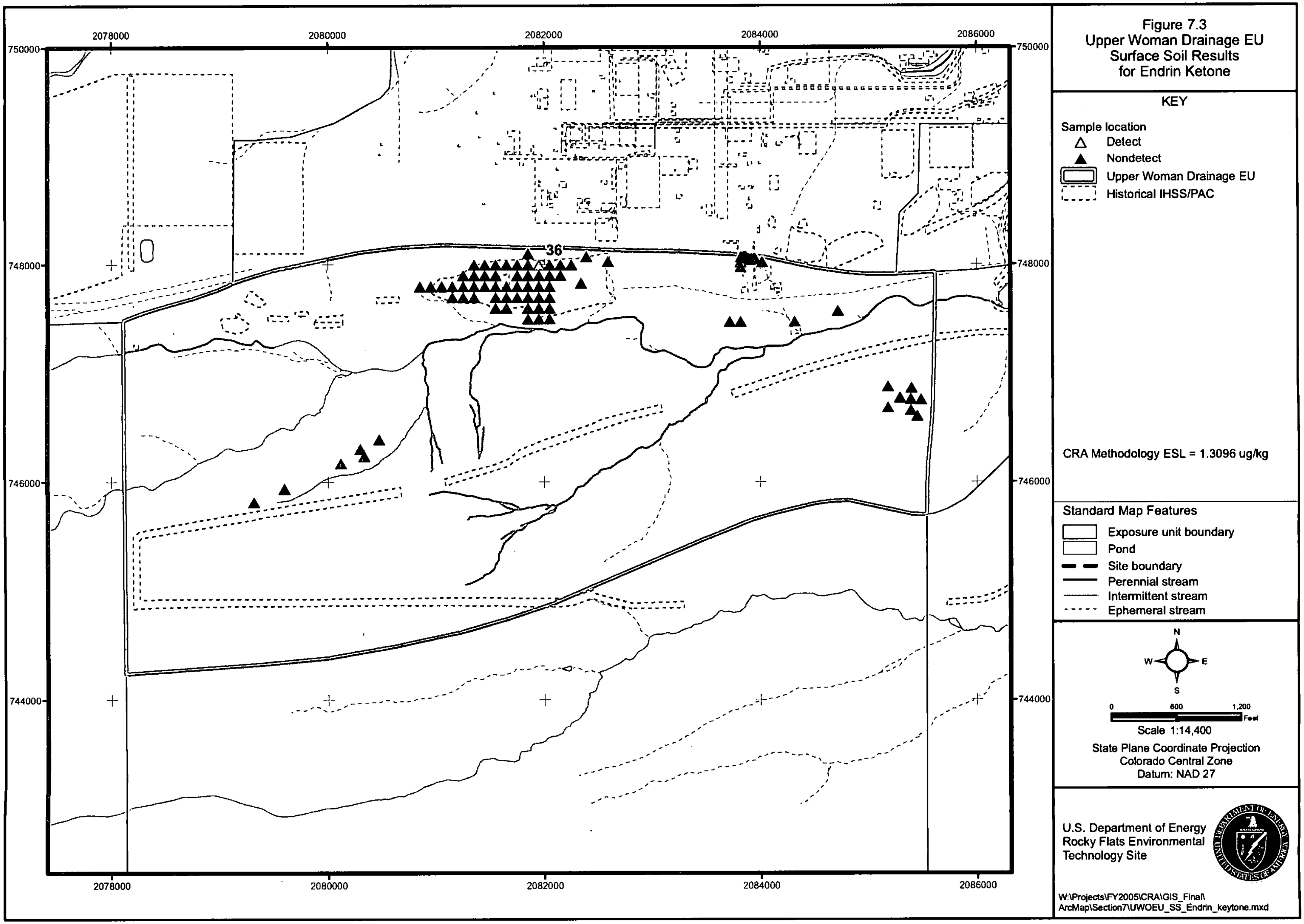



Figure 7.3
Upper Woman Drainage EU
Surface Soil Results
for Endrin Ketone

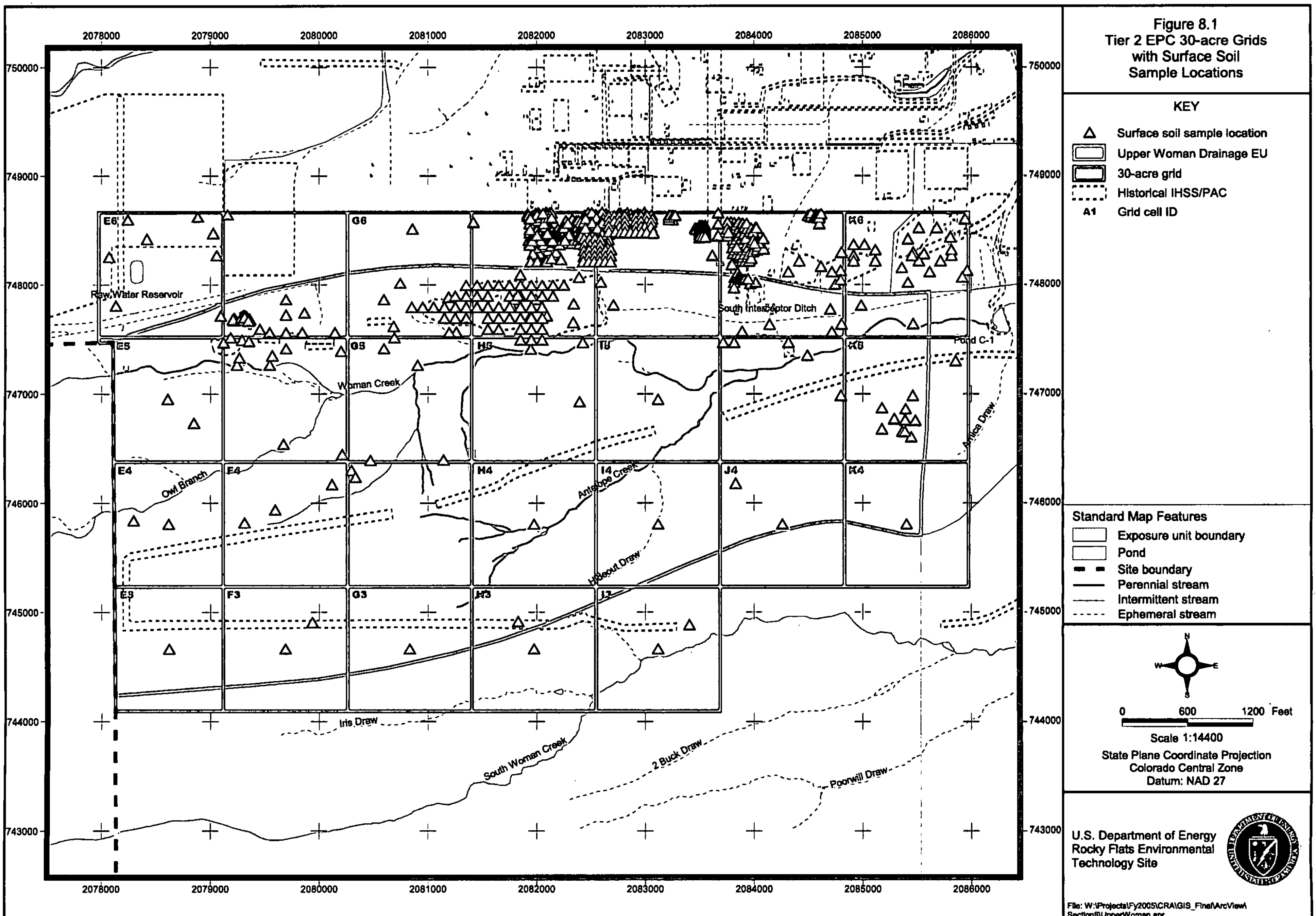
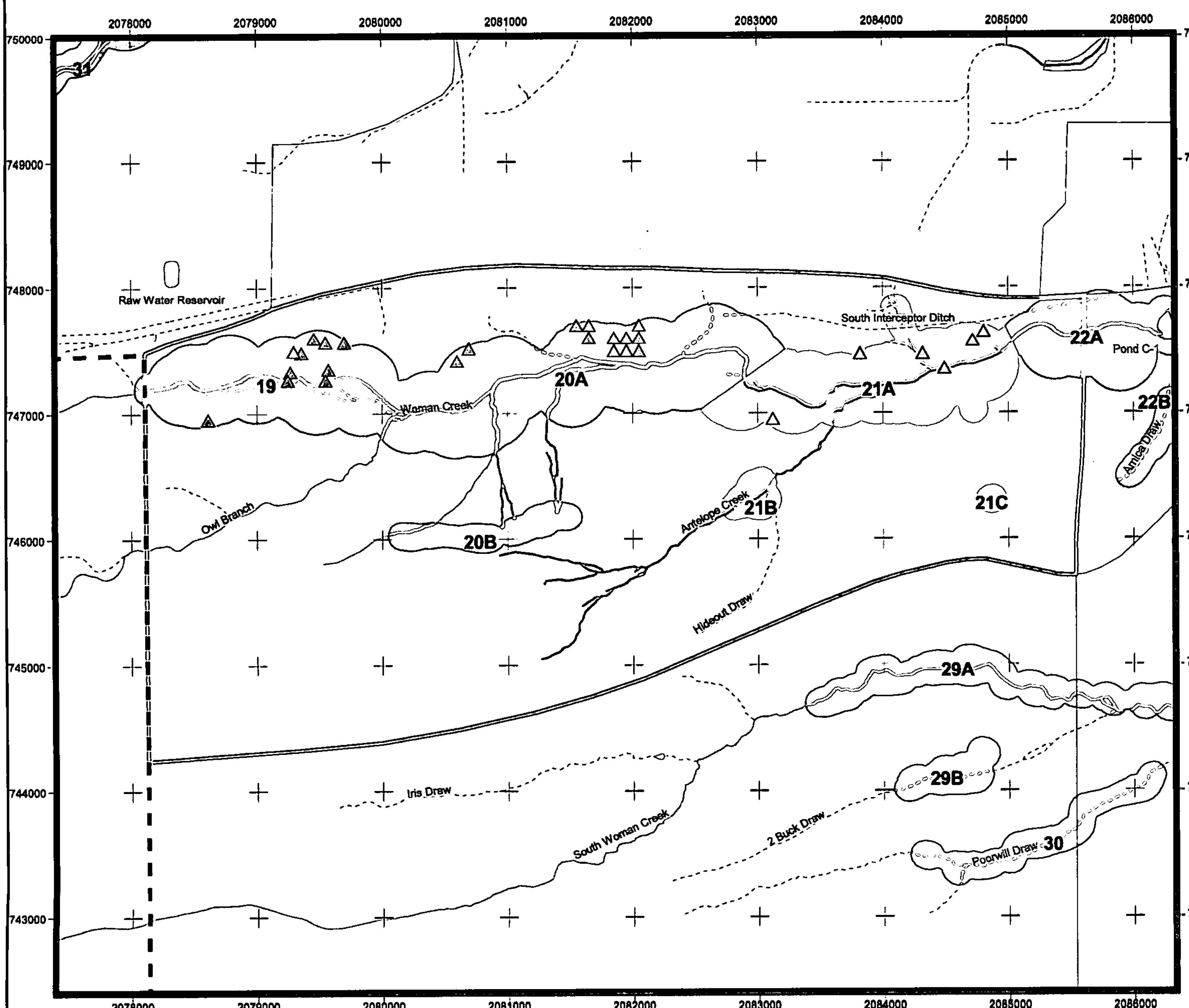



Figure 8.1
Tier 2 EPC 30-acre Grids
with Surface Soil
Sample Locations

## Figure 8.2
## Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Antimony




**KEY**

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 1.0 mg/kg
Maximum background concentration: N/A

**Standard Map Features**

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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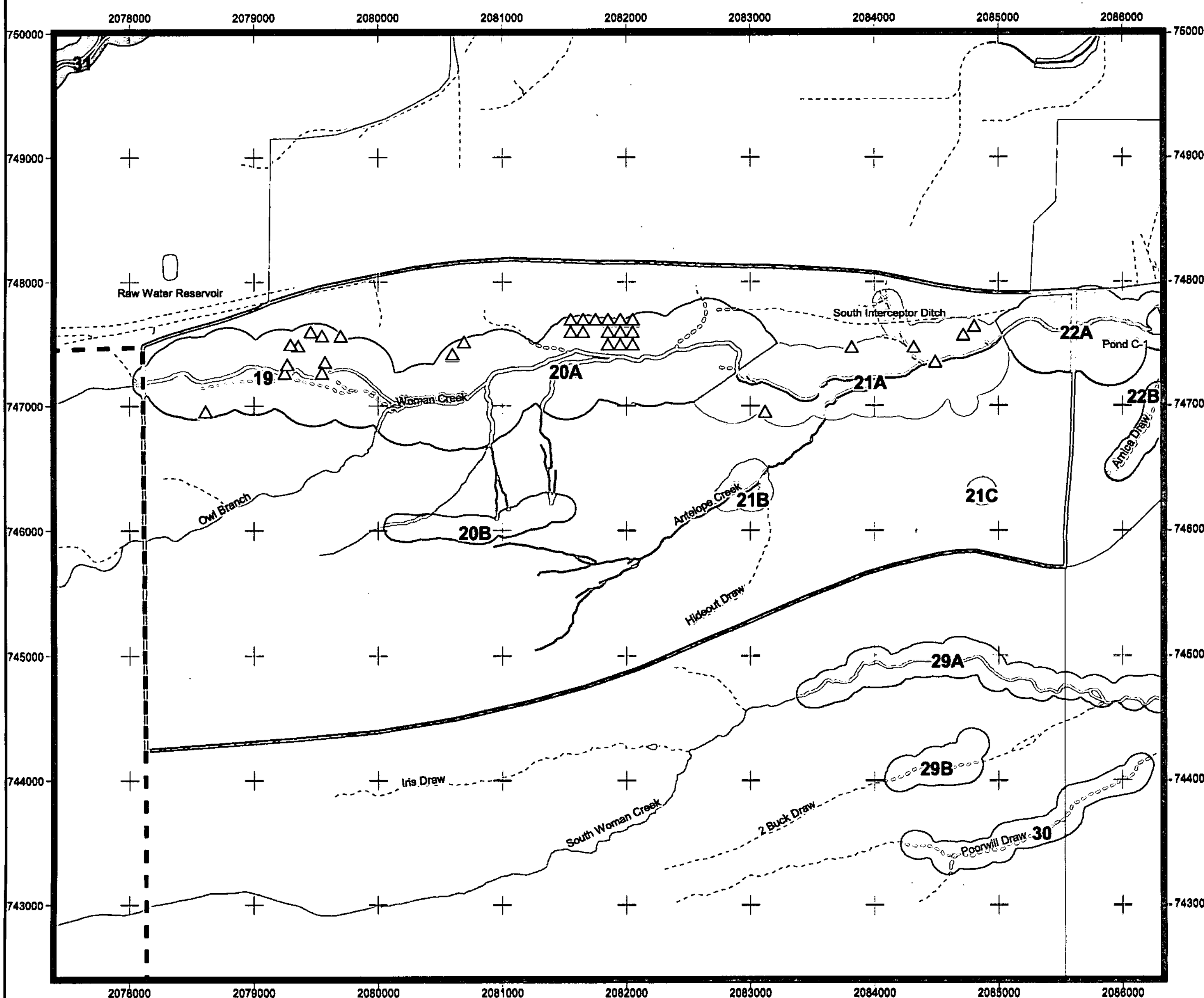
## Figure 8.3
## Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Chromium




KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 19.26 mg/kg
Maximum background concentration: 16.9 mg/kg

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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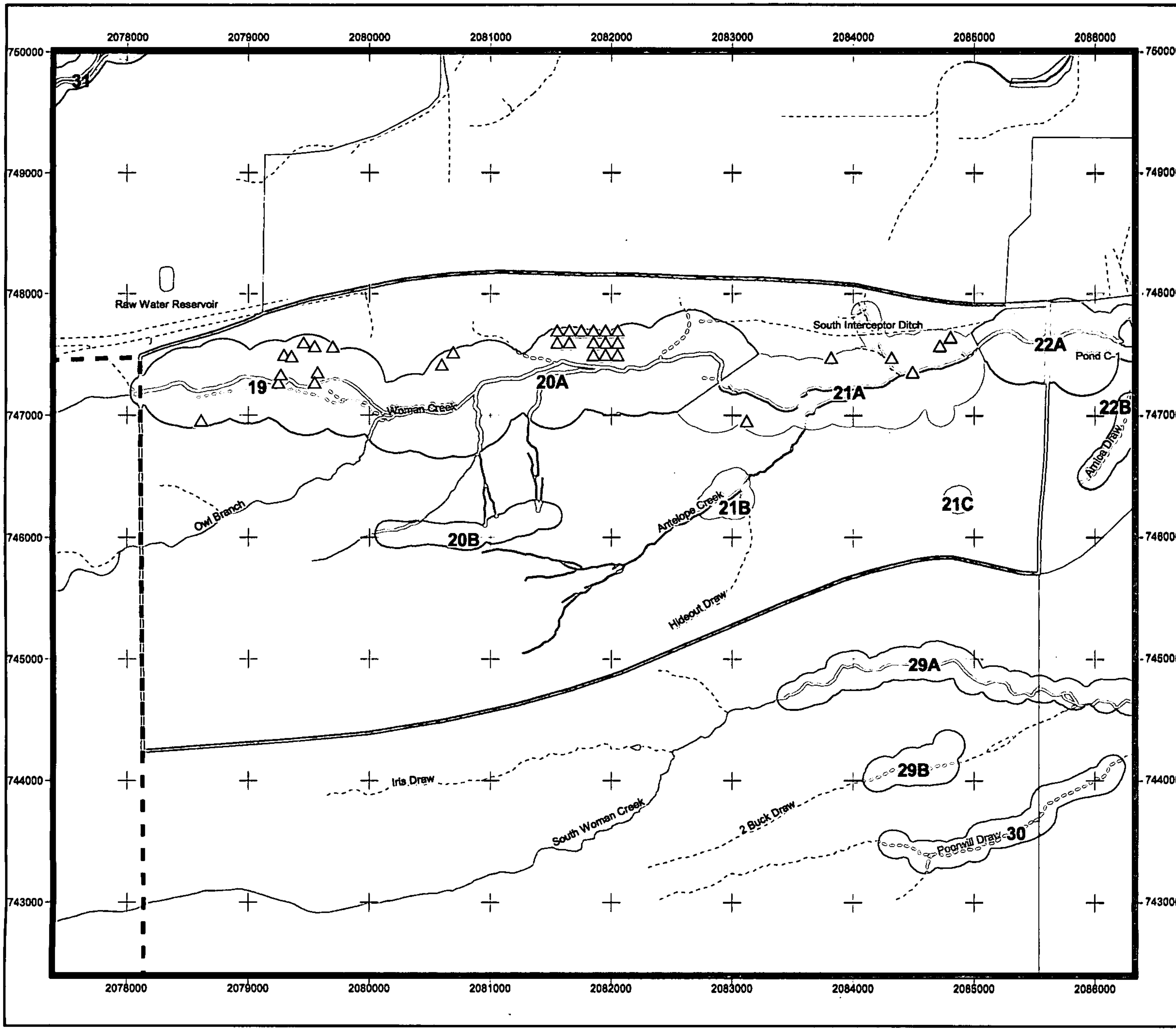
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\UpperWoman.apr




# Figure 8.4
## Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Copper

### KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 94.97 mg/kg
Maximum background concentration: 16 mg/kg

### Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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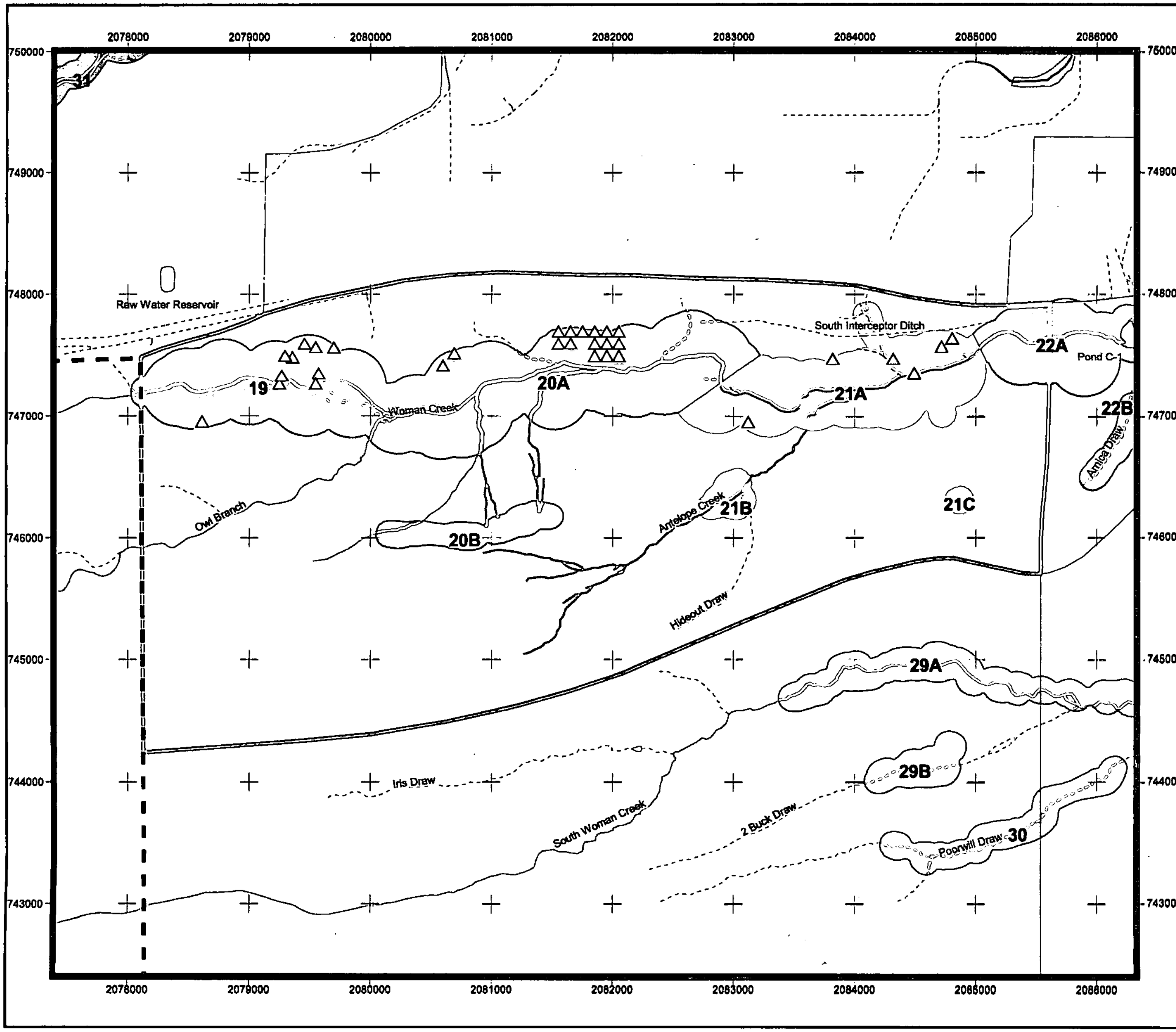


## Figure 8.5
## Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Manganese

### KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 387.9 mg/kg
Maximum background concentration: 357 mg/kg

### Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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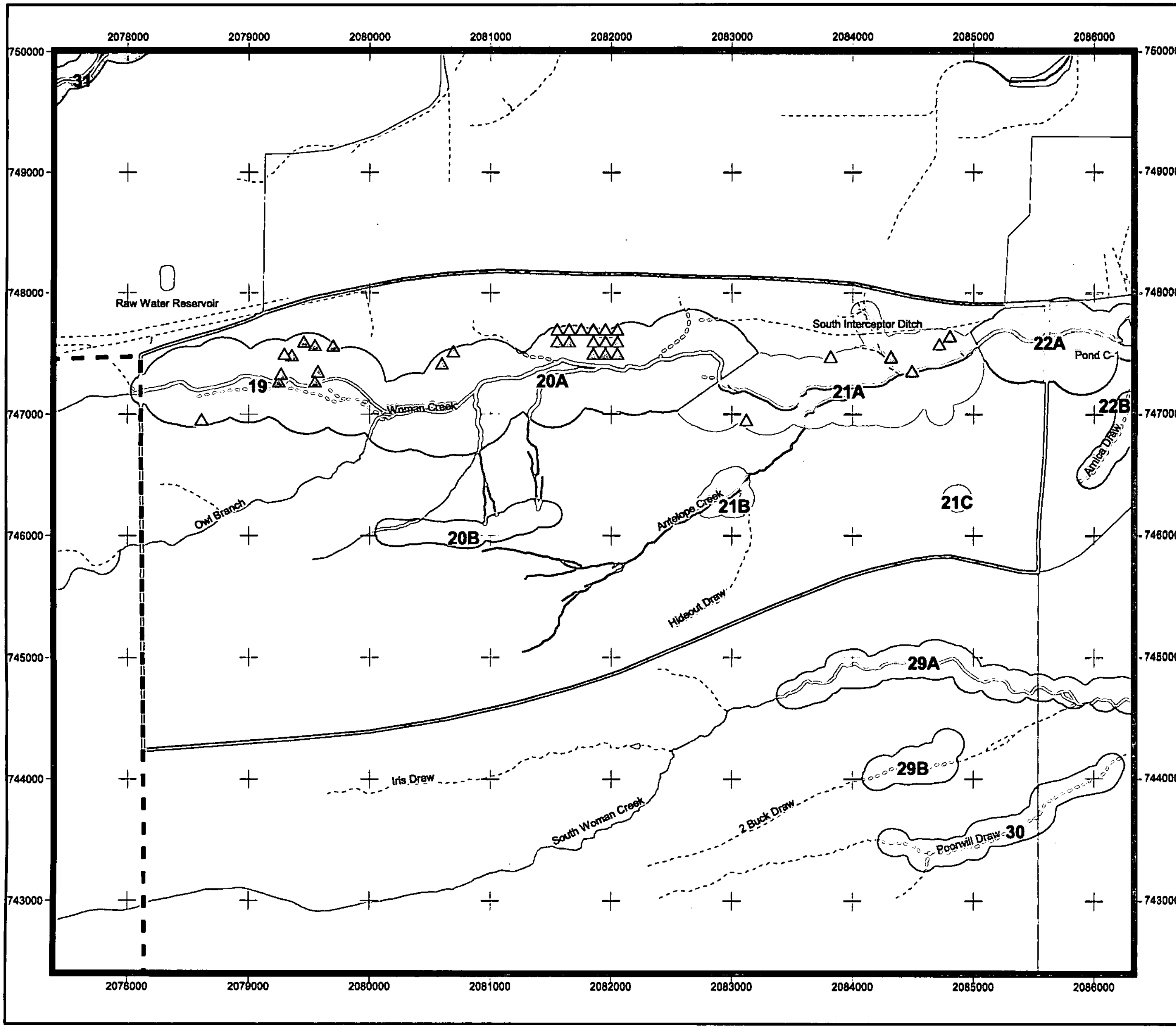


**Figure 8.6**
**Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Molybdenum**

KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 1.84 mg/kg
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N S W E

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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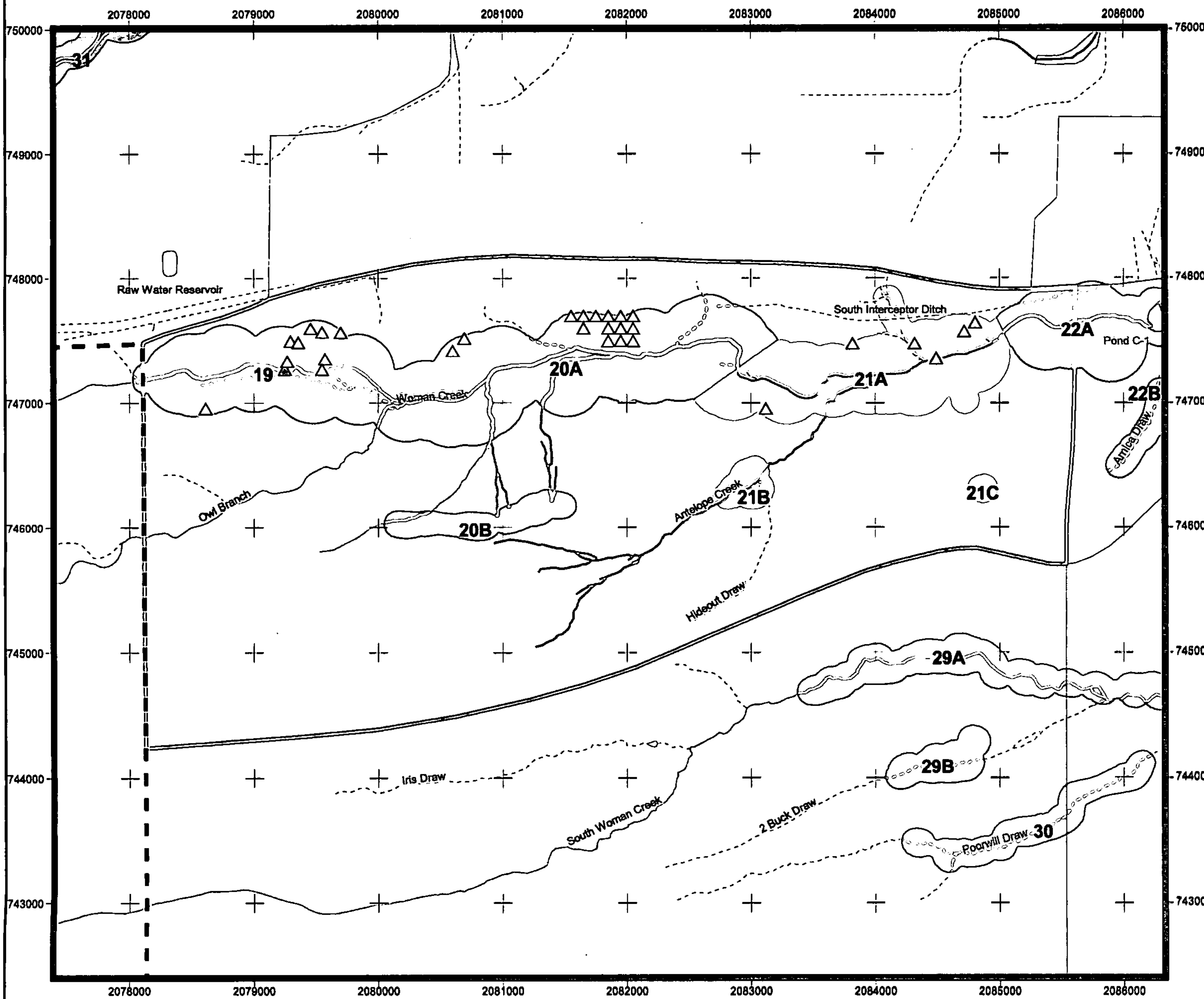


**Figure 8.7**
**Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Nickel**

KEY

Surface soil sample location

- △ Detect >= Maximum background >= 3 x ESL
- △ Detect >= Maximum background >= ESL
- △ Detect >= Maximum background < ESL
- △ Detect < Maximum background
- ▲ Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 0.51 mg/kg
Maximum background concentration: 14 mg/kg

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N S W E

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
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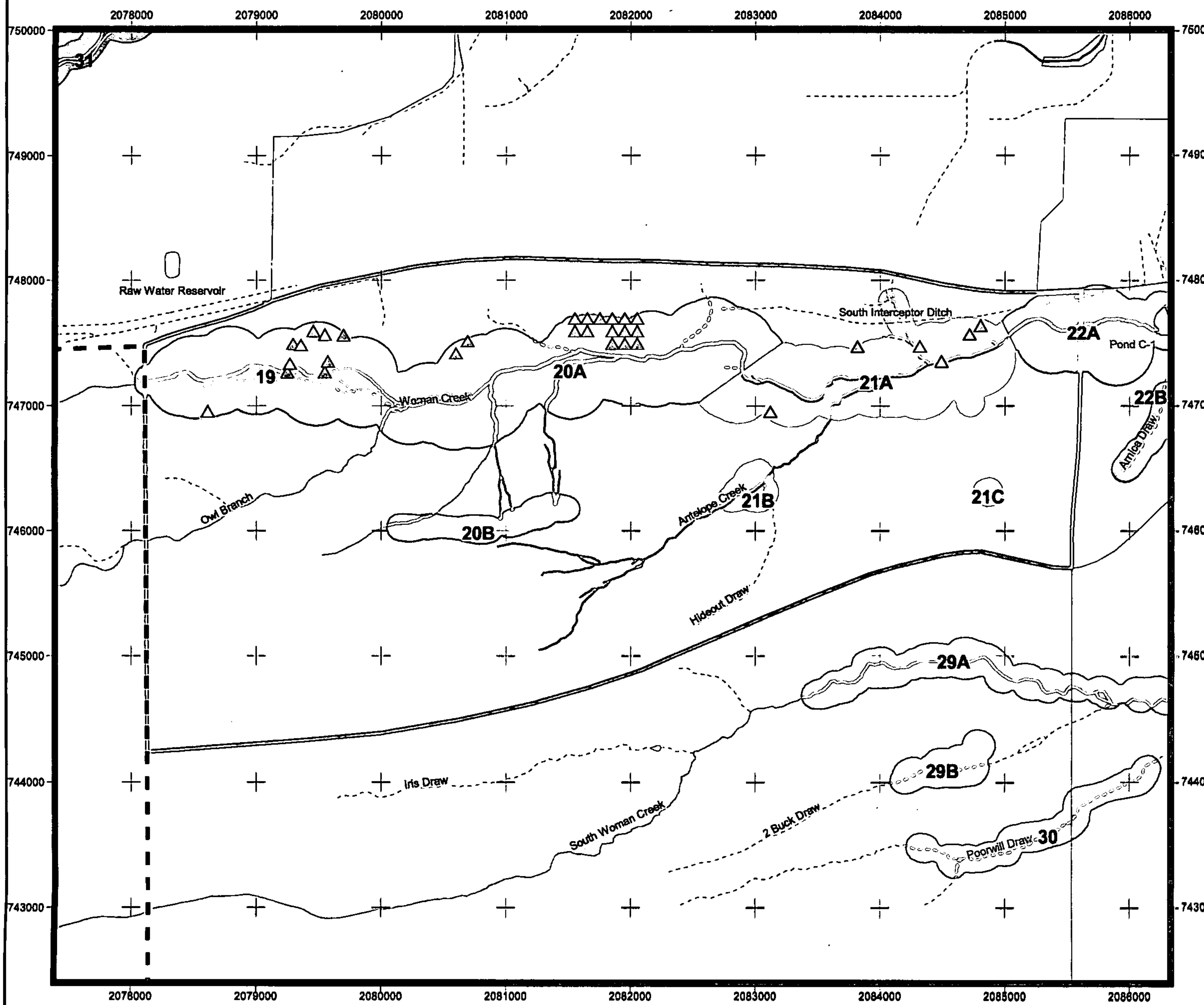
# Figure 8.8
# Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Tin




KEY

Surface soil sample location

- △ Detect >= Maximum background >= 3 x ESL
- △ Detect >= Maximum background >= ESL
- △ Detect >= Maximum background < ESL
- △ Detect < Maximum background
- ▲ Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 4.21 mg/kg
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N S E W

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
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Datum: NAD 27

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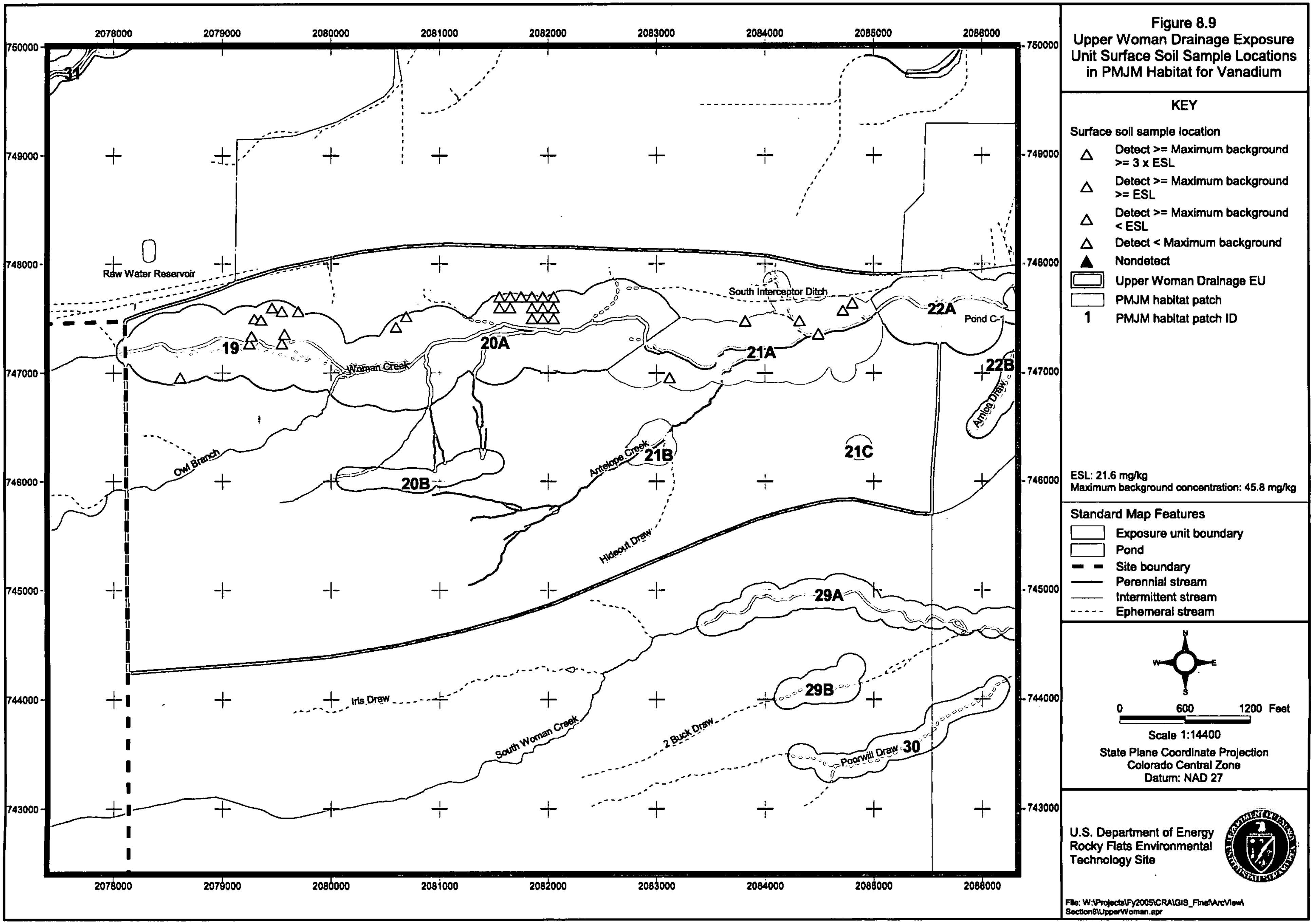

Figure 8.9
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Vanadium
KEY
Surface soil sample location
Detect >= Maximum background >= 3 x ESL
Detect >= Maximum background >= ESL
Detect >= Maximum background < ESL
Detect < Maximum background
Nondetect
Upper Woman Drainage EU
PMJM habitat patch
1 PMJM habitat patch ID
ESL: 21.6 mg/kg
Maximum background concentration: 45.8 mg/kg
Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
0 600 1200 Feet
Scale 1:14400
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
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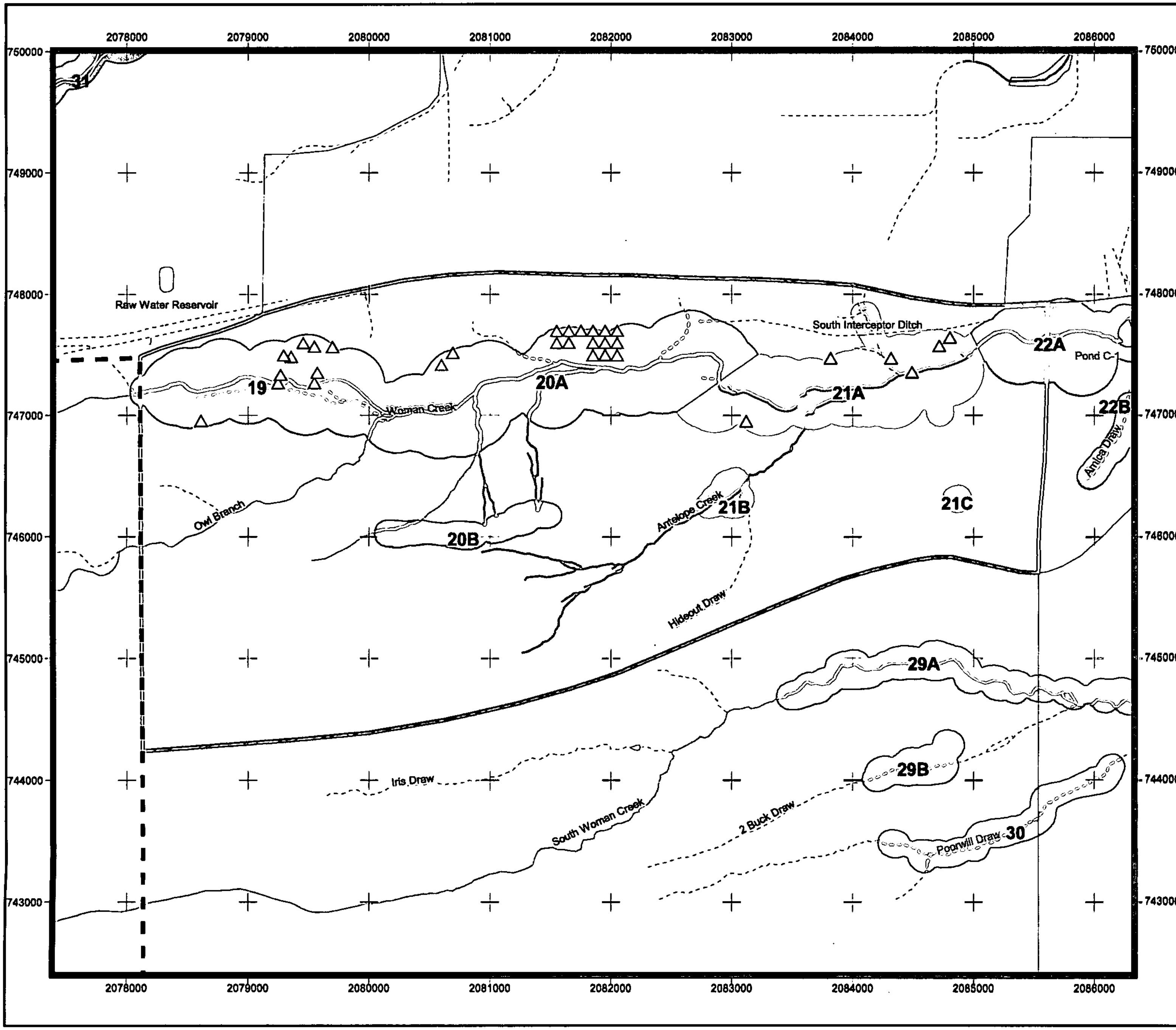
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\UpperWoman.apr
Raw Water Reservoir
South Interceptor Ditch
Woman Creek
Owl Branch
Antelope Creek
Hideout Draw
Iris Draw
South Woman Creek
2 Buck Draw
Poorwill Draw
Arnica Draw
Pond C-1
19
20A
20B
21A
21B
21C
22A
22B
29A
29B
30
31
2078000
2079000
2080000
2081000
2082000
2083000
2084000
2085000
2086000
750000
749000
748000
747000
746000
745000
744000
743000

Figure 8.10
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Zinc




KEY

Surface soil sample location

- △ Detect >= Maximum background >= 3 x ESL
- △ Detect >= Maximum background >= ESL
- △ Detect >= Maximum background < ESL
- △ Detect < Maximum background
- ▲ Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 6.4 mg/kg
Maximum background concentration: 75.9 mg/kg

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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0 600 1200 Feet

Scale 1:14400

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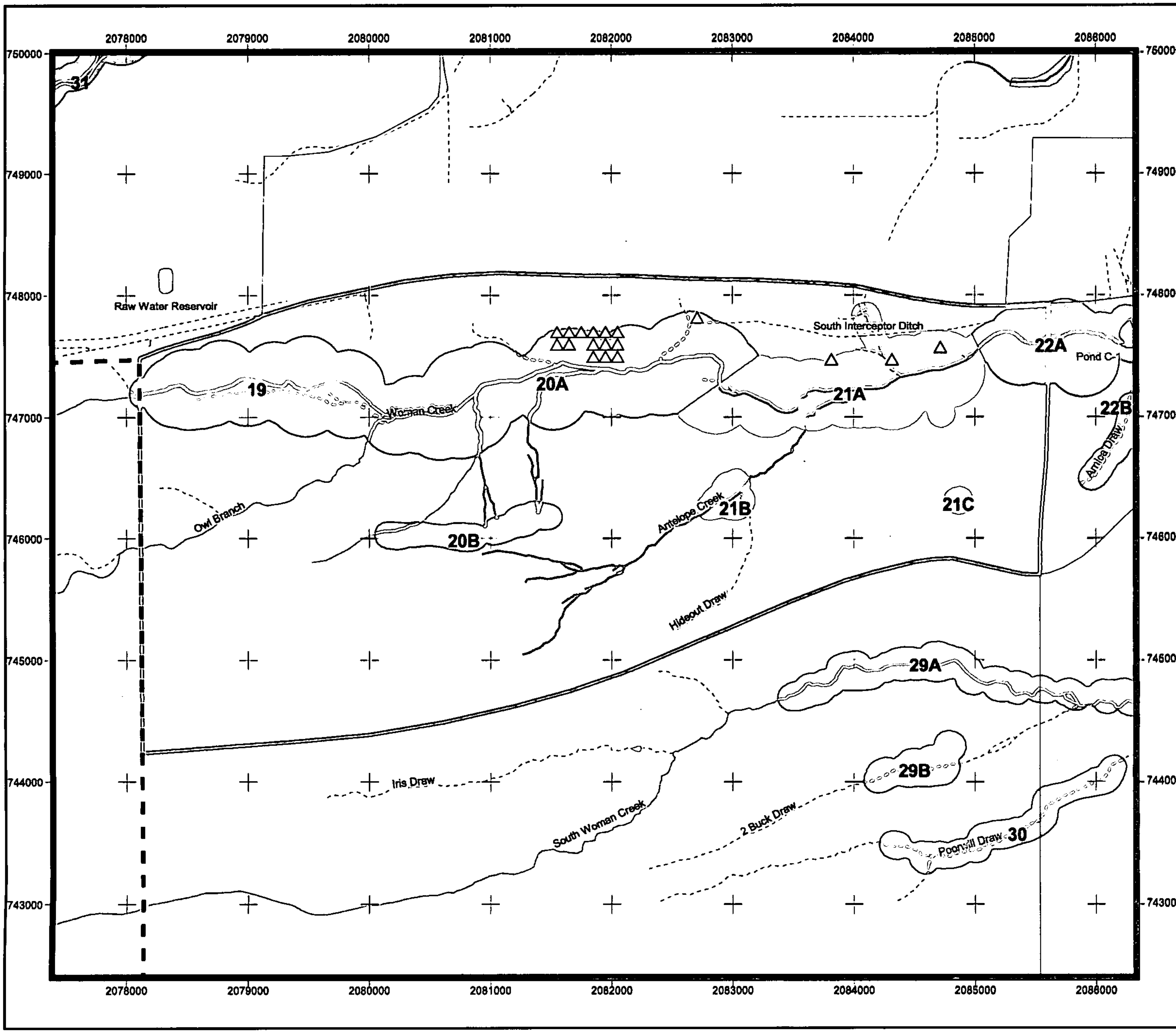


**Figure 8.11**
**Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Total PCBs**

**KEY**

Surface soil sample location
- △ Detect >= 3 x ESL
- △ Detect >= ESL
- △ Detect < ESL
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 1349.8 mg/kg
Maximum background concentration: N/A

**Standard Map Features**
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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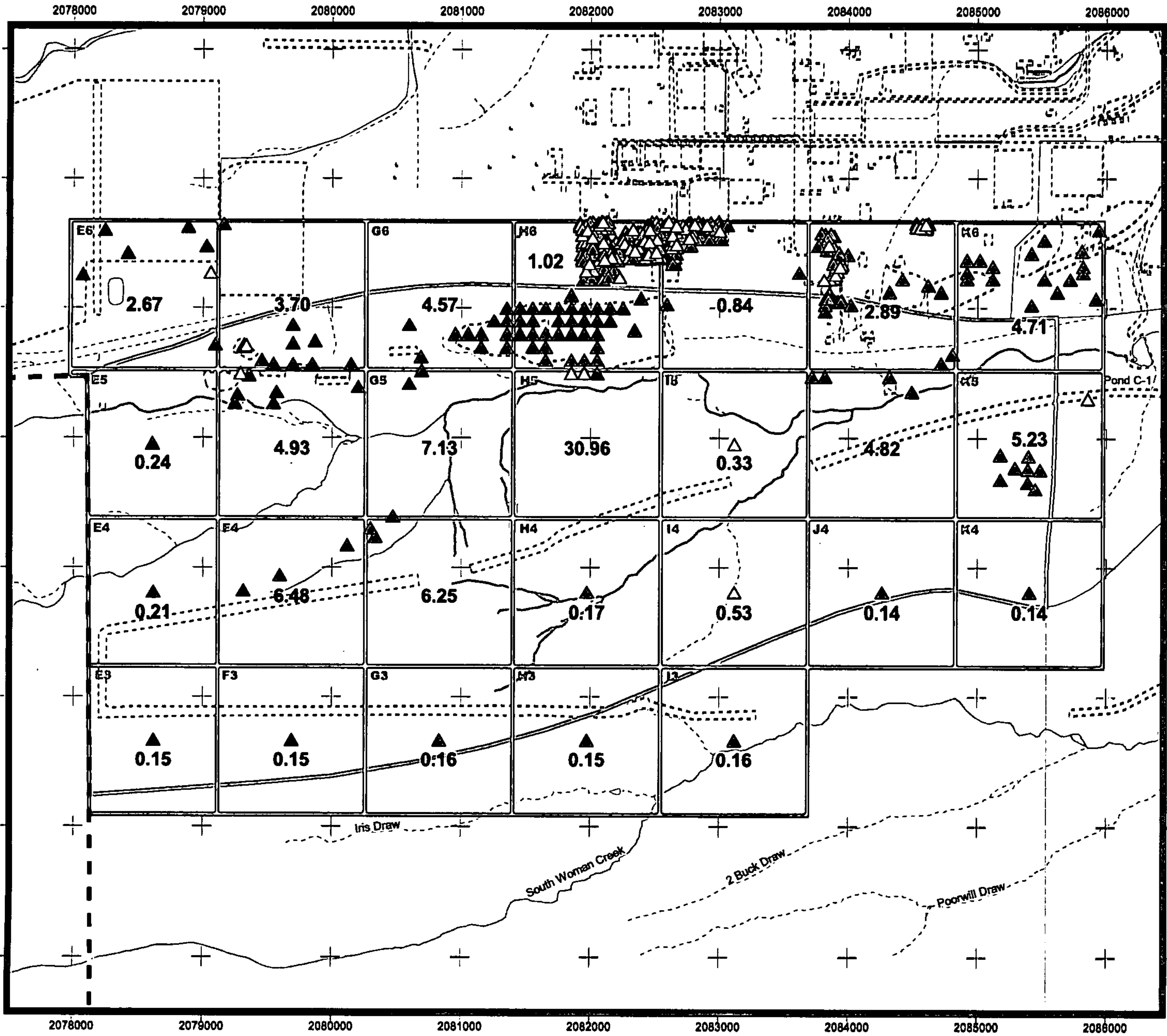


Figure 10.1
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Antimony

KEY

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 0.905 mg/kg
Receptor: Deer Mouse - Insectivore
95th UCL background: 0.309 mg/kg
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N E S W

0 600 1200 Feet

Scale 1:14400

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Datum: NAD 27

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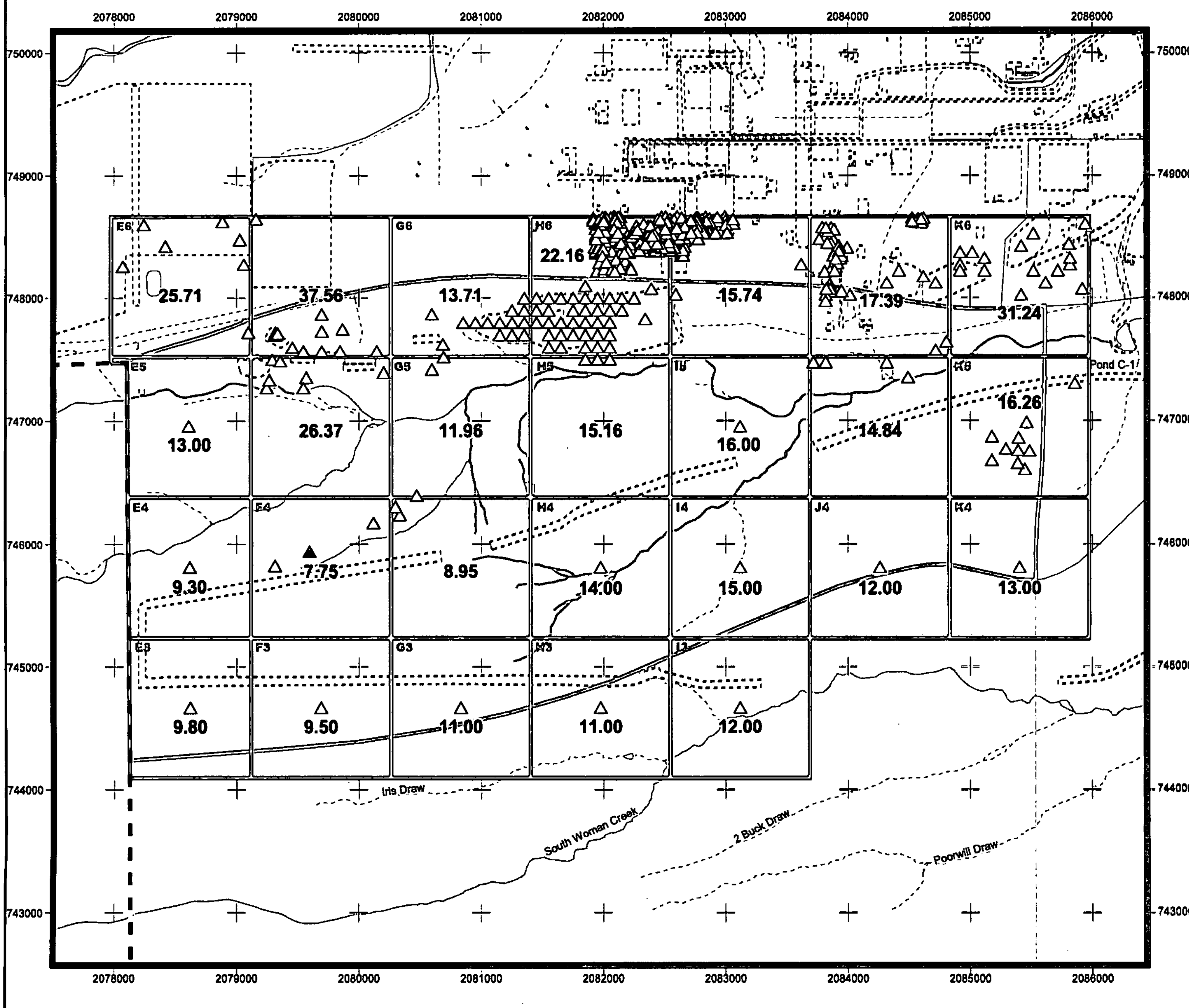
## Figure 10.2
## Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Copper




**KEY**

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 8.25 mg/kg
Receptor: Mourning Dove - Insectivore
95th UCL background: 14 mg/kg
Maximum background concentration: 16 mg/kg

**Standard Map Features**
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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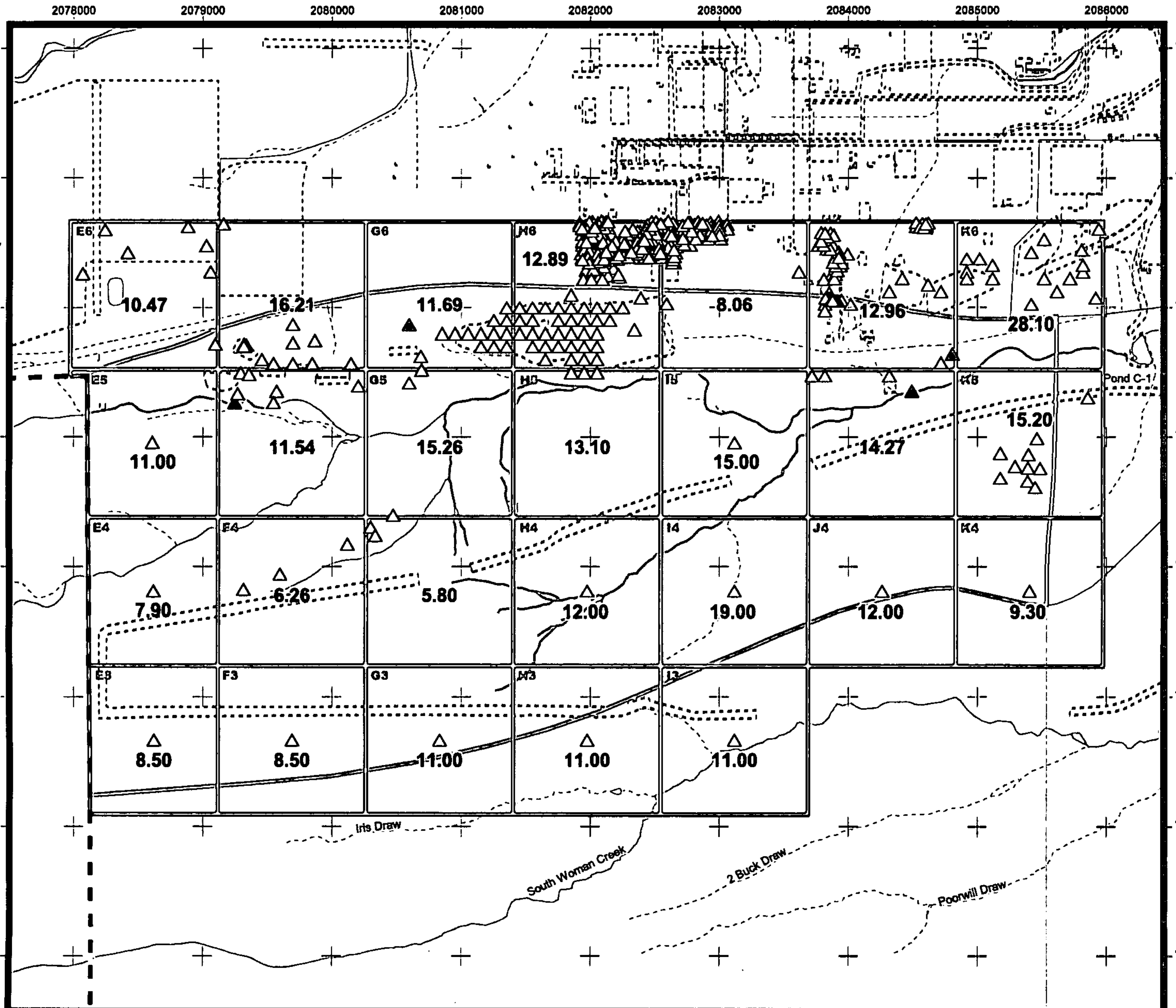


# Figure 10.3
# Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Nickel

**KEY**

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 0.431 mg/kg
Receptor: Deer Mouse - Insectivore
95th UCL background: 10.6 mg/kg
Maximum background concentration: 14 mg/kg

**Standard Map Features**
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N S E W

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
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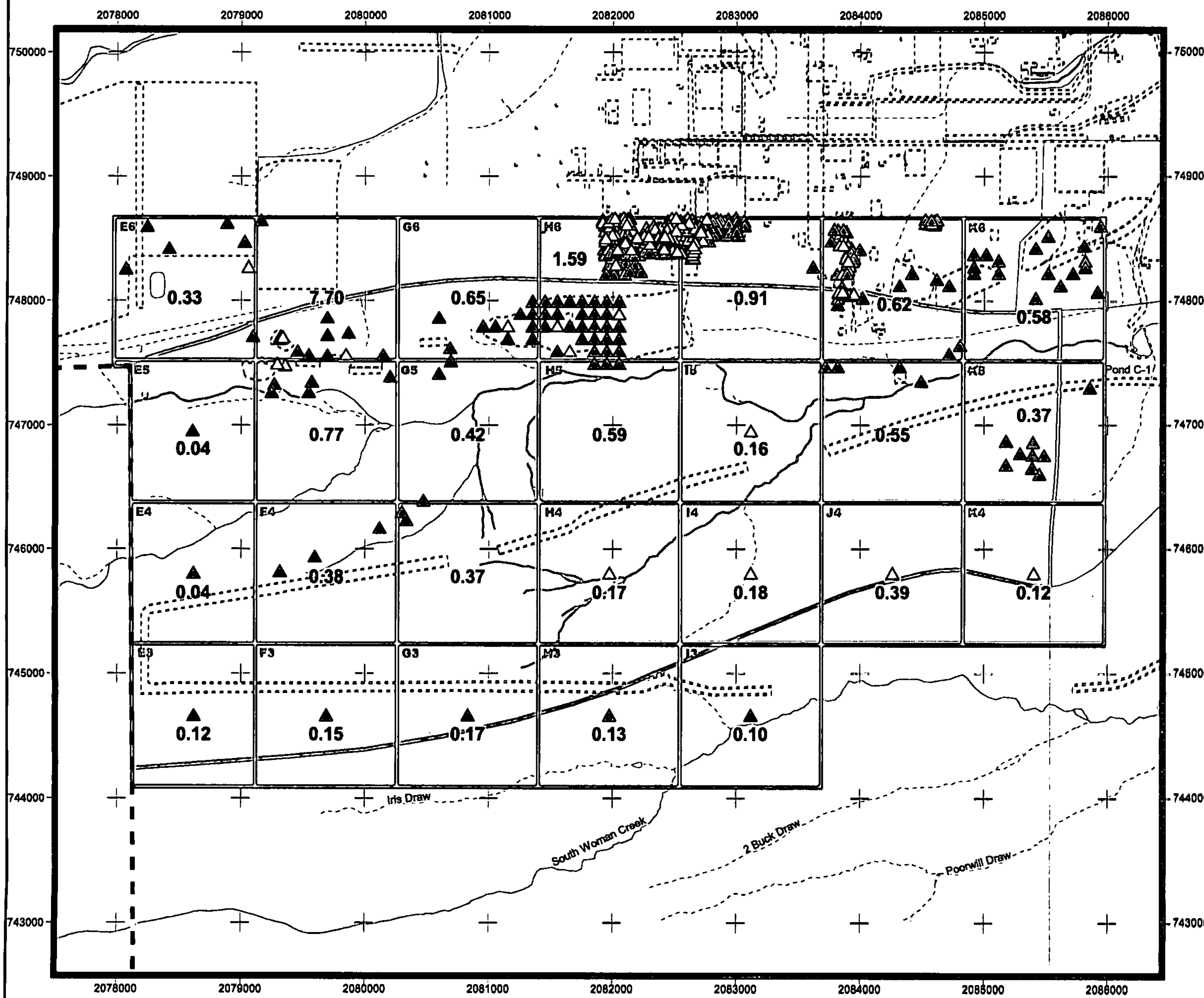


# Figure 10.4
## Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Silver

**KEY**

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 2 mg/kg
Receptor: Terrestrial Plants
95th UCL background: 0.21 mg/kg
Maximum background concentration: N/A

**Standard Map Features**

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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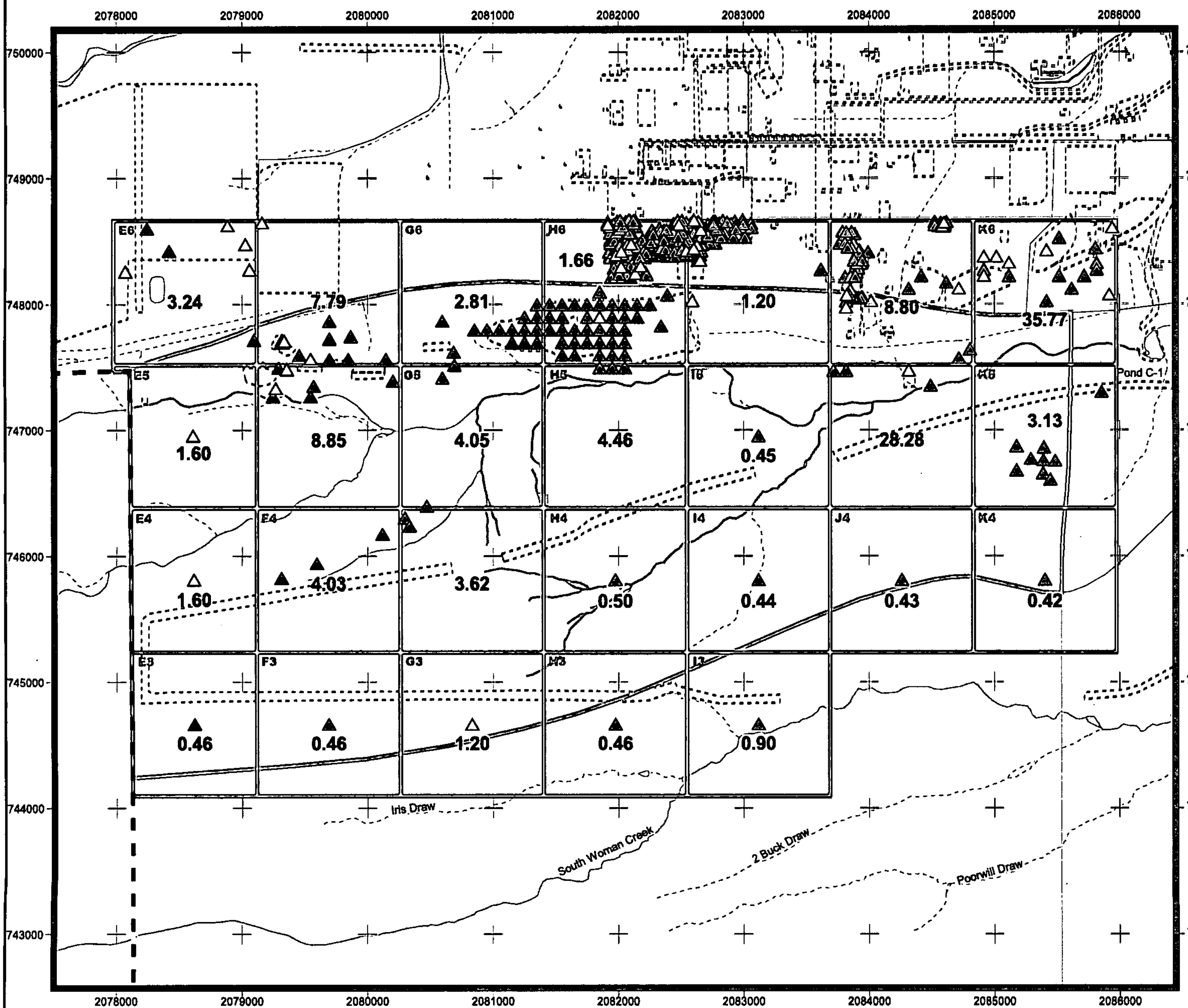
## Figure 10.5
## Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Tin




### KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 2.9 mg/kg
Receptor: Mourning Dove - Insectivore
95th UCL background: 2.22 mg/kg
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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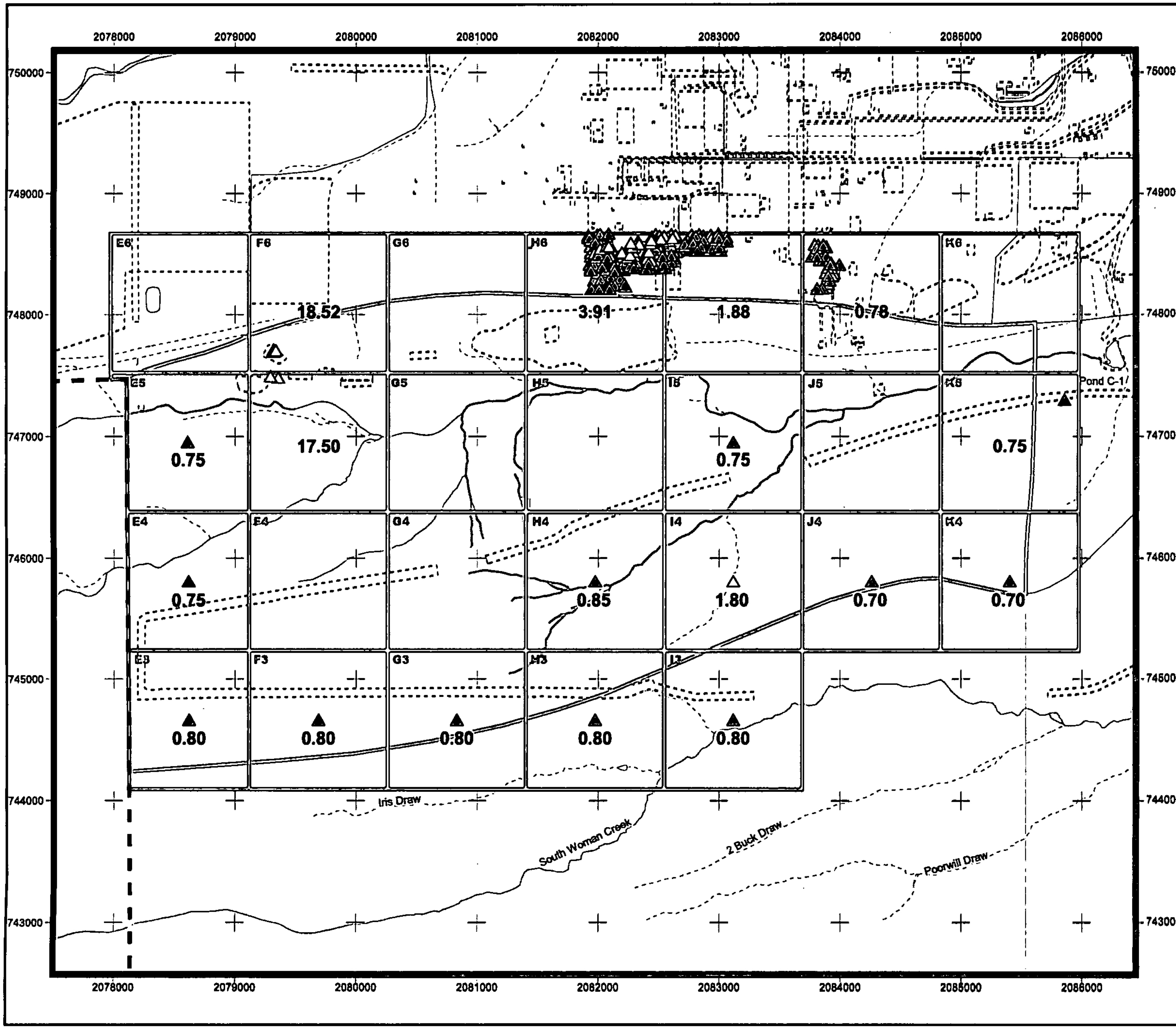


Figure 10.6
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Uranium

KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 5 mg/kg
Receptor: Terrestrial Plants
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N E S W

0 600 1200 Feet

Scale 1:14400
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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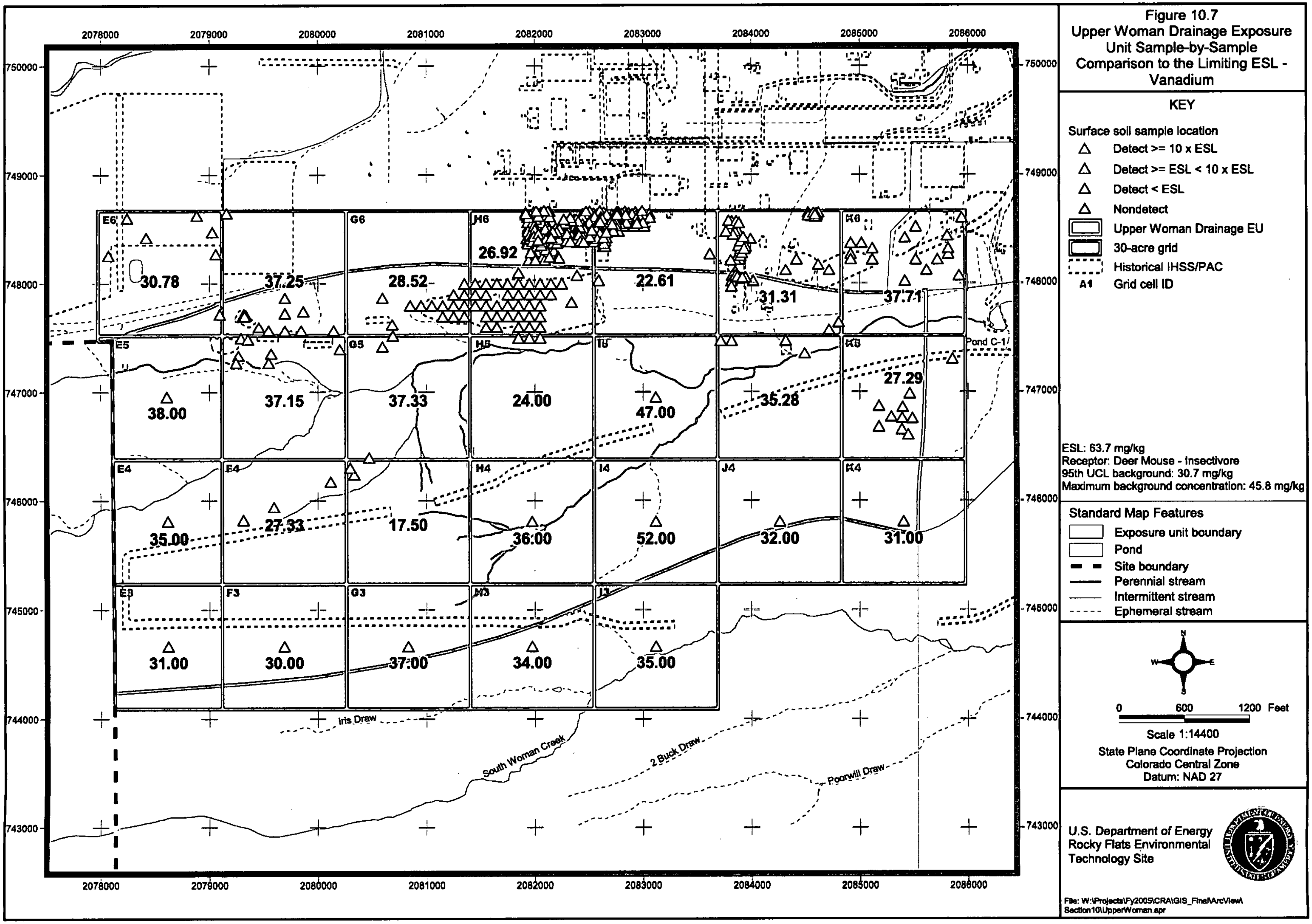

Figure 10.7
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Vanadium
KEY
Surface soil sample location
Detect >= 10 x ESL
Detect >= ESL < 10 x ESL
Detect < ESL
Nondetect
Upper Woman Drainage EU
30-acre grid
Historical IHSS/PAC
A1 Grid cell ID
ESL: 63.7 mg/kg
Receptor: Deer Mouse - Insectivore
95th UCL background: 30.7 mg/kg
Maximum background concentration: 45.8 mg/kg
Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
0 600 1200 Feet
Scale 1:14400
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
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2078000
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749000
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747000
746000
745000
744000
743000
E6
30.78
37.25
G6
28.52
H6
26.92
22.61
31.31
K6
37.71
E5
38.00
37.15
G5
37.33
H5
24.00
I5
47.00
35.28
K5
27.29
Pond C-1
E4
35.00
F4
27.33
17.50
H4
36.00
I4
52.00
J4
32.00
K4
31.00
E3
31.00
F3
30.00
G3
37.00
H3
34.00
I3
35.00
Iris Draw
South Woman Creek
2 Buck Draw
Poorwill Draw

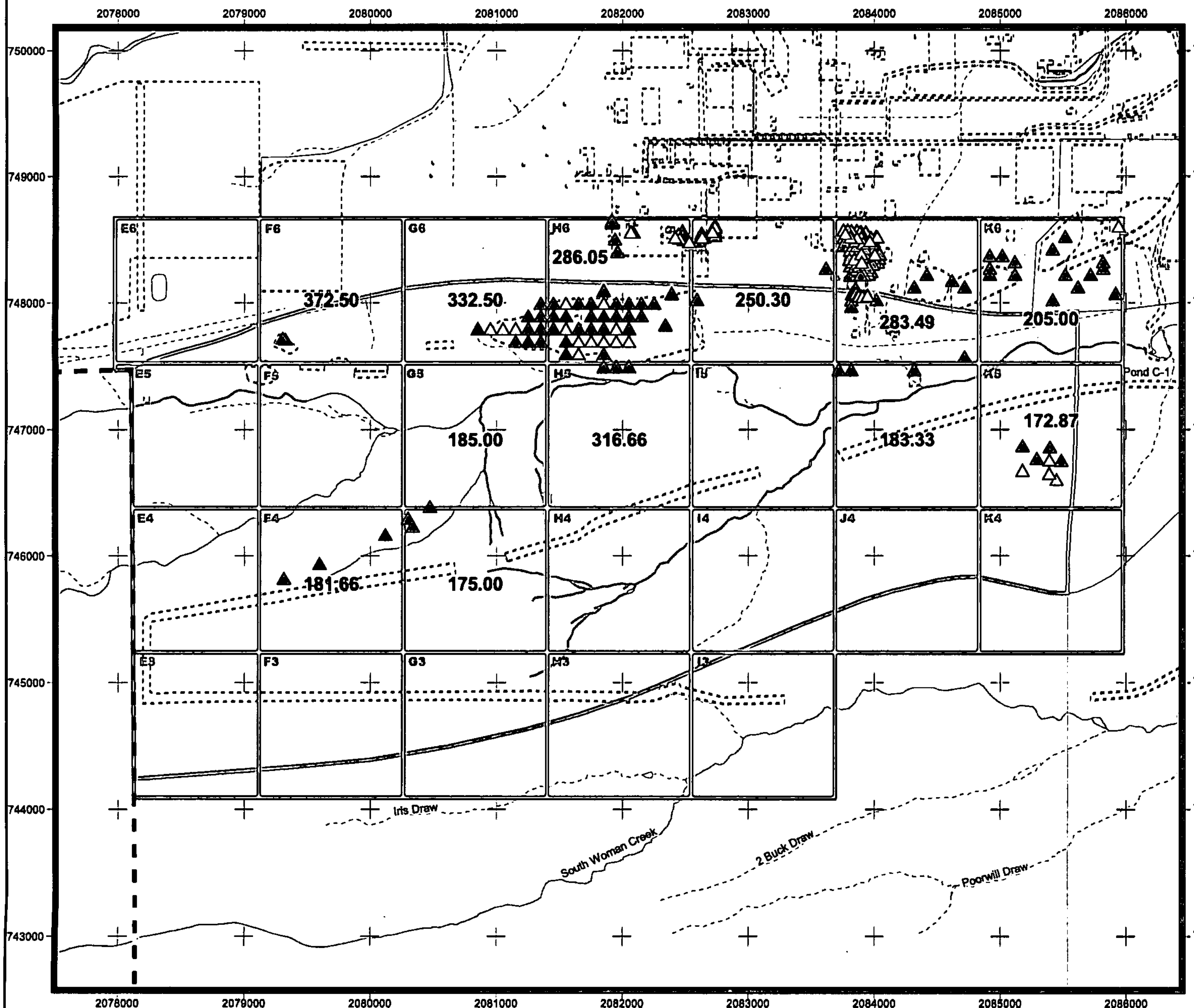


Figure 10.8
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Bis(2-ethylhexyl)phthalate

KEY

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 136.8 ug/kg
Receptor: Mourning Dove - Insectivore
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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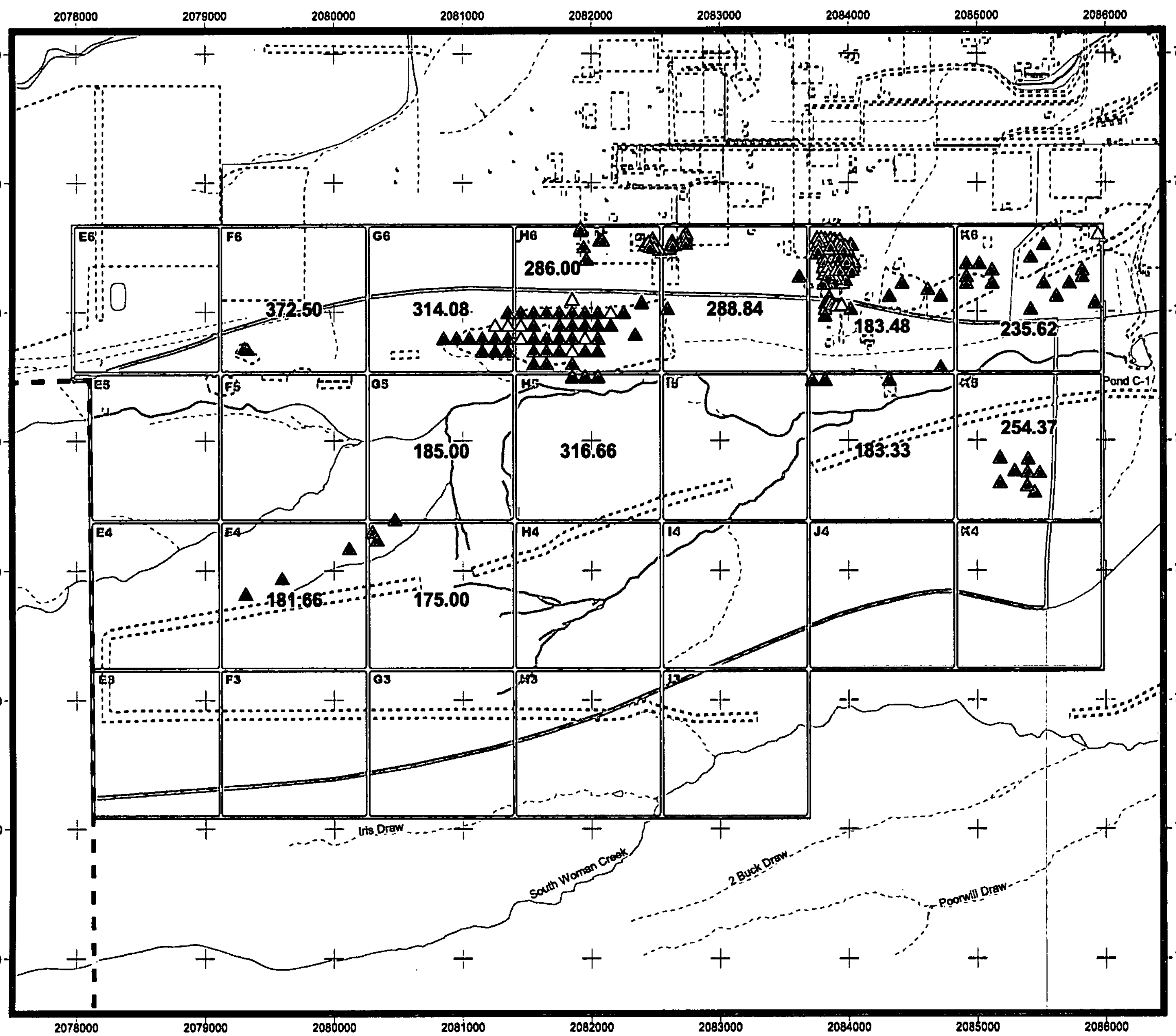


# Figure 10.9
## Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Di-n-butylphthalate

### KEY

Surface soil sample location
- △ Detect >= 10 x ESL
- △ Detect >= ESL < 10 x ESL
- △ Detect < ESL
- △ Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 15.86 ug/kg
Receptor: Mourning Dove - Insectivore
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N E S W

0 600 1200 Feet

Scale 1:14400
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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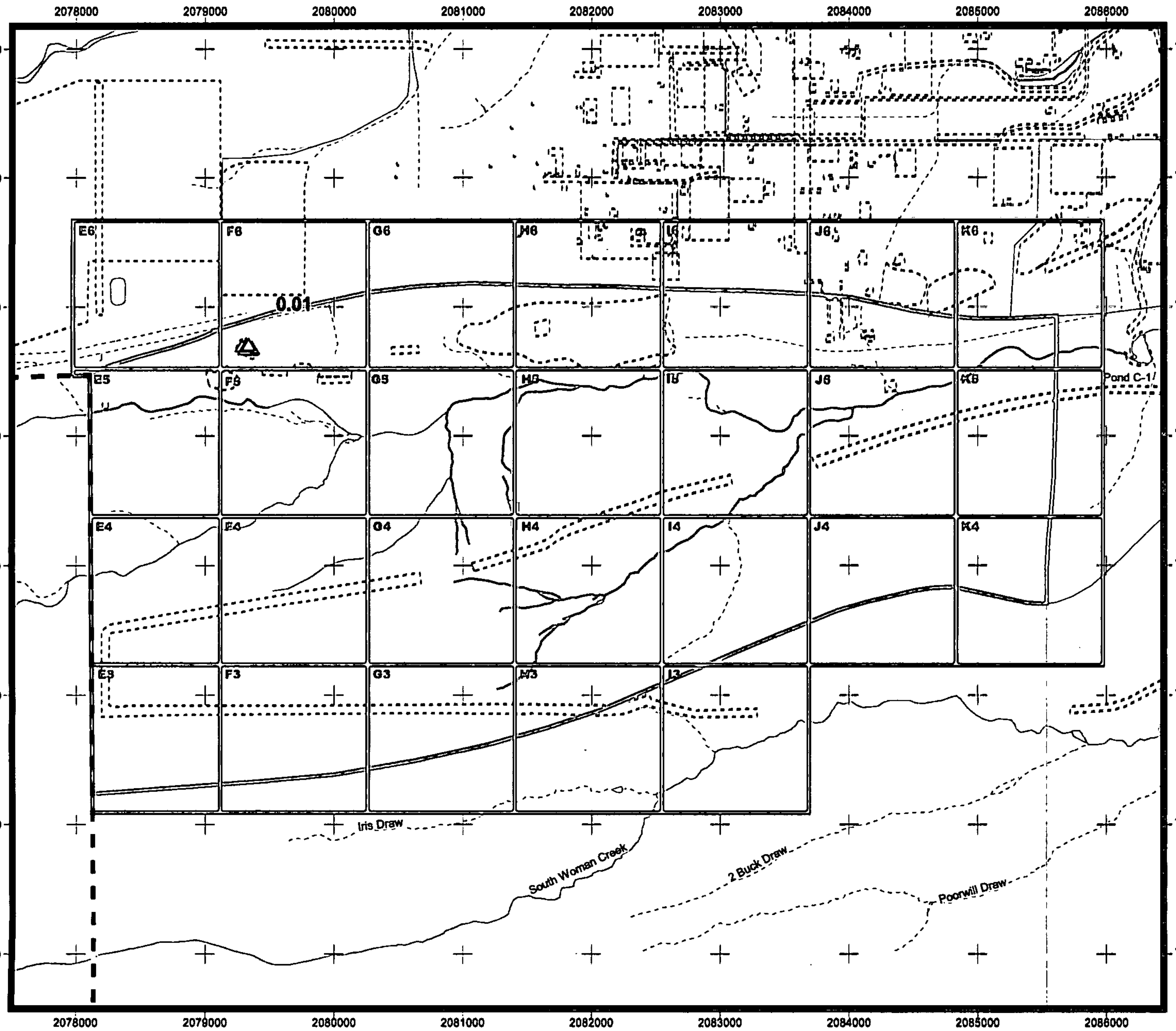
# Figure 10.10
## Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Total Dioxins




KEY

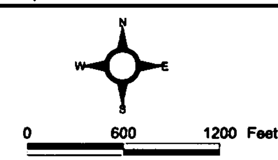
Surface soil sample location

- △ Detect >= 10 x ESL
- △ Detect >= ESL < 10 x ESL
- △ Detect < ESL
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 0.0042 ug/kg
Receptor: Deer Mouse - Insectivore
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream




Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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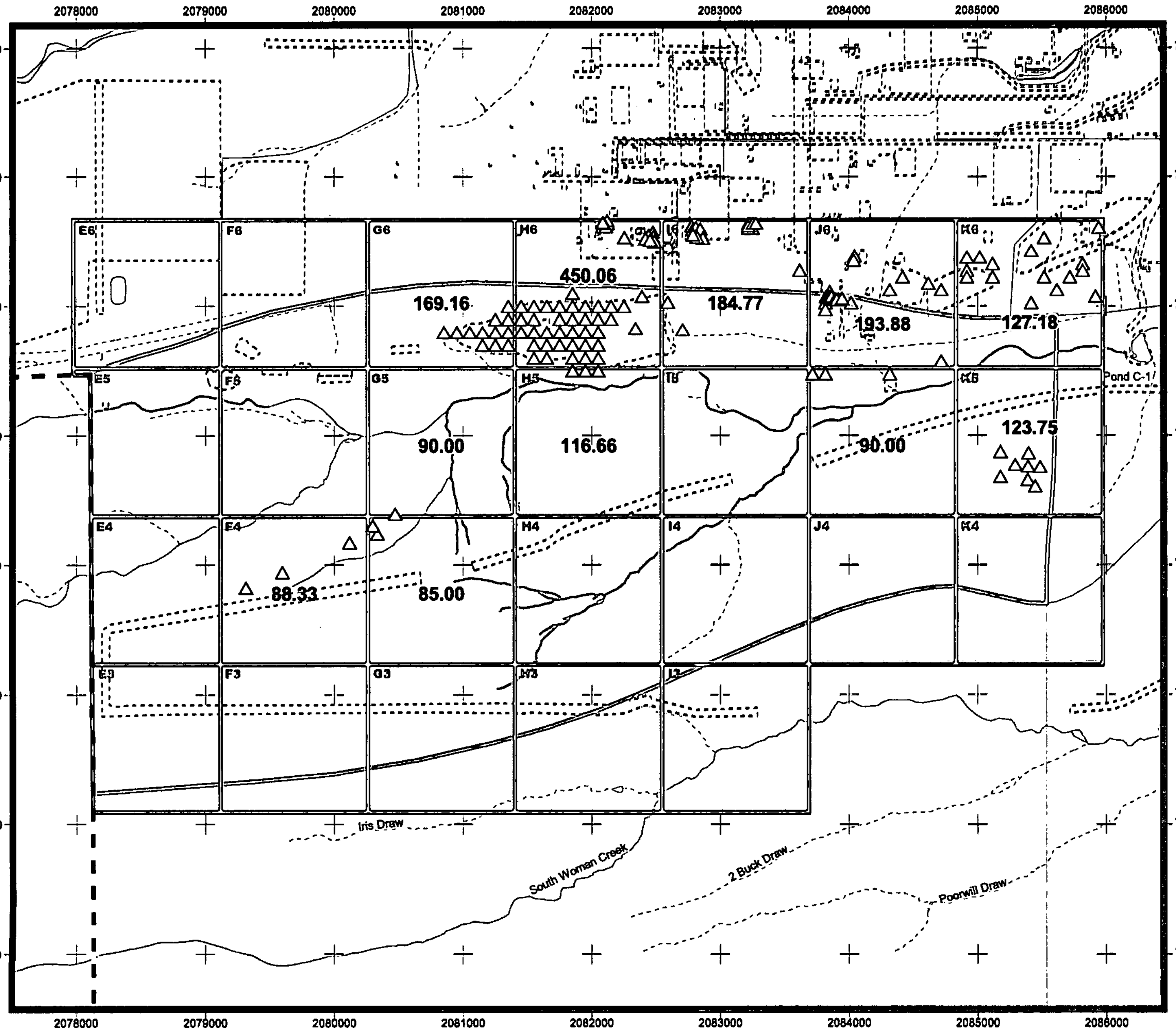


**Figure 10.11**
**Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Total PCBs**

**KEY**

Surface soil sample location
- △ Detect >= 10 x ESL
- △ Detect >= ESL < 10 x ESL
- △ Detect < ESL
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 42.3 ug/kg
Receptor: Mourning Dove - Insectivore
95th UCL background: N/A
Maximum background concentration: N/A

**Standard Map Features**
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 600 1200 Feet
Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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# COMPREHENSIVE RISK ASSESSMENT

## UPPER WOMAN DRAINAGE EXPOSURE UNIT

## VOLUME 10: ATTACHMENT 1

## Detection Limit Screen

# TABLE OF CONTENTS



## LIST OF TABLES

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ECOI | Ecological Contaminant of Interest |
| ERA | Ecological Risk Assessment |
| ESL | ecological screening level |
| EU | Exposure Unit |
| HHRA | Human Health Risk Assessment |
| PCOC | Potential Chemical of Concern |
| PRG | preliminary remediation goal |
| UWOEU | Upper Woman Exposure Unit |
| WRW | Wildlife Refuge Worker |

# 1.0 EVALUATION OF DETECTION LIMITS FOR NONDETECTED ANALYTES IN THE UPPER WOMAN DRAINAGE EXPOSURE UNIT

The detection limits for analytes not detected in, or detected in less than 5 percent of, the samples collected in the media used in the Human Health Risk Assessment (HHRA) or the Ecological Risk Assessment (ERA) are compared to human health preliminary remediation goals (PRGs) for the wildlife refuge worker (WRW) and ecological screening levels (ESLs) for a variety of ecological receptors. The comparisons are made in Tables A1.1 through A1.4 for potential contaminants of concern (PCOCs) in surface soil/surface sediment and subsurface soil/subsurface sediment, and ecological contaminants of interest (ECOIs) in surface soil and subsurface soil. The reported detection limits (referred to as "reported results" in the following sections of this attachment) are listed in these tables for each medium in the Upper Woman Drainage Exposure Unit (EU) (UWOEU). When reported results exceed the respective PRGs and ESLs, this is a source of uncertainty in the risk assessment process, and these occurrences are noted and discussed. The reported results are the lowest levels at which the analyte could be accurately and reproducibly quantified, taking into account the sample characteristics, sample collection, sample preparation, and analytical adjustments. The term analyte as used in the following sections refers to analytes that are nondetected or detected in less than 5 percent of the samples.

## 1.1 Comparison of Maximum Reported Results to Preliminary Remediation Goals

### 1.1.1 Surface Soil/Surface Sediment

The maximum reported detection limits for four analytes in surface soil/surface sediment, 3,3-dichlorobenzidine, dibenz(a,h)anthracene, and n-nitroso-di-n-propylamine, and Aroclor-1260 are greater than the PRG (Table A1.1). The minimum reported detections for these analytes are below the PRG. Because the exceedances of the maximum detection limits over the PRG are small, and the detection limits for the majority of the analytes were much lower than the PRG, the uncertainties associated with detection limits greater than the PRGs are not expected to have a significant impact on the results of the risk assessment.

PRGs are not available for two inorganics and several organic analytes in surface soil/surface sediment (Table A1.1). Because PRGs are available for most of the nondetected analytes in surface soil/surface sediment, and the maximum reported results for these analytes are much lower than the PRGs, the lack of PRGs for a few analytes is unlikely to have a significant effect on the results of the risk assessment. In addition, the fact that no identified source exists for these analytes in the UWOEU indicates that the uncertainty associated with the reported results for these analytes is acceptable.

### 1.1.2 Subsurface Soil/Subsurface Sediment

One analyte in subsurface soil/subsurface sediment, n-nitroso-di-n-propylamine, had maximum reported results that exceed the PRG in subsurface soil/subsurface sediment (Table A1.2). This is not expected to have a significant effect on the risk assessment.

PRGs are not available for several organic analytes in subsurface soil/subsurface sediment (Table A1.2). Because PRGs are available for most of the organics in subsurface soil/subsurface sediment, and the maximum reported results for these analytes are much lower than the PRGs, the lack of PRGs for only a few organics is unlikely to have a significant effect on the results of the risk assessment. In addition, the fact that no identified source exists for these analytes in the UWOEU indicates that the uncertainty associated with the reported results for these analytes is acceptable.

## 1.2 Comparison of Maximum Reported Results to Ecological Screening Levels

### 1.2.1 Surface Soil

The maximum reported results for several analytes in surface soil are greater than the ESL (Table A1.3). However, a large number of analytes in surface soil have maximum reported results that are much less than the ESLs, indicating that the detection limits are adequate for most analytes. In addition, because there is no indication that the analytes with maximum reported results above the ESLs are present at the UWOEU, this is not expected to impact the conclusions of the risk assessment.

ESLs are not available for several organic analytes in surface soil (Table A1.3). Because ESLs are available for most of the organics in surface soil, and the maximum reported results for these analytes are much lower than the ESLs, the lack of ESLs for these organics is unlikely to have a significant effect on the results of the risk assessment. In addition, the fact that no identified source exists for these analytes in the UWOEU indicates that the uncertainty associated with the reported results for these analytes is acceptable.

### 1.2.2 Subsurface Soil

The minimum and maximum reported results for all analytes in subsurface soil are below their respective ESLs, except those for 2,4-dinitrotoluene (Table A1.4). This is not expected to impact the results of the risk assessment.

ESLs were not available for several analytes in subsurface soil (Table A1.4). Because the maximum reported results for analytes with ESLs available are generally much lower than the ESLs, suggesting that these analytes are not present at levels near the ESLs, the lack of ESLs for some analytes is not likely to have a significant effect on the results of the risk assessment.

# TABLES

**Table A1.1**
**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil/Surface Sediment**

| Analyte | Range of Reported Results | | | Total Number of Results | PRG | Maximum Result > PRG?[a] |
|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)** | | | | | | |
| Chloride | 25 | - | 25 | 2 | N/A | N/A |
| Nitrite | 0.3 | - | 2.5 | 3 | 11,109 | No |
| Sulfate | 25 | - | 25 | 2 | N/A | N/A |
| **Organics (mg/kg)** | | | | | | |
| 1,1,1,2-Tetrachloroethane | 1.256 | - | 5.9 | 8 | 91,018 | No |
| 1,1,1-Trichloroethane | 1.114 | - | 28 | 32 | 9.18E+06 | No |
| 1,1,2,2-Tetrachloroethane | 0.98 | - | 28 | 32 | 10,483 | No |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 0.993 | - | 5.9 | 8 | 2.38E+09 | No |
| 1,1,2-Trichloroethane | 0.944 | - | 28 | 32 | 28,022 | No |
| 1,1-Dichloroethane | 1.001 | - | 28 | 32 | 2.72E+06 | No |
| 1,1-Dichloroethene | 1.504 | - | 28 | 32 | 17,366 | No |
| 1,1-Dichloropropene | 1.277 | - | 5.9 | 8 | N/A | N/A |
| 1,2,3-Trichlorobenzene | 0.713 | - | 5.9 | 8 | N/A | N/A |
| 1,2,3-Trichloropropane | 1.053 | - | 5.9 | 8 | 2,079 | No |
| 1,2,4-Trichlorobenzene[b] | 0.986 | - | 1000 | 117 | 151,360 | No |
| 1,2-Dibromo-3-chloropropane | 1.832 | - | 5.9 | 8 | 2,968 | No |
| 1,2-Dibromoethane | 0.836 | - | 5.9 | 8 | 35.1 | No |
| 1,2-Dichlorobenzene | 0.744 | - | 1000 | 118 | 2.89E+06 | No |
| 1,2-Dichloroethane | 1.014 | - | 28 | 32 | 13,270 | No |
| 1,2-Dichloroethene | 5 | - | 28 | 24 | 999,783 | No |
| 1,2-Dichloropropane | 0.871 | - | 28 | 32 | 38,427 | No |
| 1,3,5-Trimethylbenzene | 0.99 | - | 5.9 | 8 | 114,340 | No |
| 1,3-Dichlorobenzene | 1.037 | - | 1000 | 118 | 3.33E+06 | No |
| 1,3-Dichloropropane | 0.589 | - | 5.9 | 8 | N/A | N/A |
| 1,4-Dichlorobenzene | 1.125 | - | 1000 | 118 | 91,315 | No |
| 2,2-Dichloropropane | 1.031 | - | 5.9 | 8 | N/A | N/A |
| 2,4,5-Trichlorophenol | 740 | - | 4900 | 79 | 8.01E+06 | No |
| 2,4,6-Trichlorophenol | 340 | - | 1000 | 79 | 272,055 | No |
| 2,4-Dichlorophenol | 340 | - | 1000 | 79 | 240,431 | No |
| 2,4-Dimethylphenol | 340 | - | 1000 | 79 | 1.60E+06 | No |
| 2,4-Dinitrophenol | 900 | - | 4900 | 79 | 160,287 | No |
| 2,4-Dinitrotoluene | 340 | - | 1000 | 112 | 160,287 | No |
| 2,6-Dinitrotoluene | 340 | - | 1000 | 112 | 80,144 | No |
| 2-Chloronaphthalene | 340 | - | 1000 | 112 | 6.41E+06 | No |
| 2-Chlorophenol | 340 | - | 1000 | 79 | 555,435 | No |
| 2-Chlorotoluene | 1.603 | - | 5.9 | 8 | 2.22E+06 | No |
| 2-Hexanone | 8.114 | - | 57 | 31 | N/A | N/A |
| 2-Methylnaphthalene[b] | 340 | - | 1000 | 106 | 320,574 | No |
| 2-Methylphenol | 340 | - | 1000 | 79 | 4.01E+06 | No |
| 2-Nitroaniline | 900 | - | 4900 | 109 | 192,137 | No |
| 2-Nitrophenol | 270 | - | 1000 | 79 | N/A | N/A |
| 3,3'-Dichlorobenzidine | 360 | - | 23000 | 88 | 6,667 | Yes |
| 3-Nitroaniline | 900 | - | 55000 | 94 | N/A | N/A |
| 4,4'-DDD | 3.6 | - | 170 | 112 | 15,528 | No |
| 4,4'-DDE | 3.6 | - | 170 | 112 | 10,961 | No |
| 4,4'-DDT[b] | 3.6 | - | 170 | 111 | 10,927 | No |
| 4,6-Dinitro-2-methylphenol | 900 | - | 4900 | 79 | 8,014 | No |
| 4-Bromophenyl-phenylether | 340 | - | 1000 | 112 | N/A | N/A |

**Table A1.1**
**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil/Surface Sediment**

| Analyte | Range of Reported Results | | | Total Number of Results | PRG | Maximum Result > PRG?[a] |
|---|---|---|---|---|---|---|
| 4-Chloro-3-methylphenol | 340 | - | 1500 | 79 | N/A | N/A |
| 4-Chloroaniline | 340 | - | 11000 | 103 | 320,574 | No |
| 4-Chlorophenyl-phenyl ether | 340 | - | 1000 | 112 | N/A | N/A |
| 4-Chlorotoluene | 0.94 | - | 5.9 | 8 | N/A | N/A |
| 4-Isopropyltoluene | 1.104 | - | 5.9 | 8 | N/A | N/A |
| 4-Methyl-2-pentanone[b] | 6.859 | - | 57 | 31 | 8.32E+07 | No |
| 4-Methylphenol[b] | 340 | - | 1000 | 77 | 400,718 | No |
| 4-Nitroaniline | 900 | - | 55000 | 101 | 207,917 | No |
| 4-Nitrophenol | 900 | - | 4900 | 69 | 641,148 | No |
| Acenaphthylene[b] | 340 | - | 2300 | 125 | N/A | N/A |
| Aldrin[b] | 1.8 | - | 85 | 111 | 176 | No |
| alpha-BHC | 1.8 | - | 85 | 112 | 570 | No |
| alpha-Chlordane | 1.8 | - | 850 | 111 | 10,261 | No |
| Benzyl Alcohol[b] | 340 | - | 1500 | 67 | 2.40E+07 | No |
| beta-BHC | 1.8 | - | 85 | 111 | 1,995 | No |
| beta-Chlordane | 1.8 | - | 850 | 100 | 10,261 | No |
| bis(2-Chloroethoxy) methane | 340 | - | 1000 | 112 | N/A | N/A |
| bis(2-Chloroethyl) ether | 340 | - | 1000 | 112 | 3,767 | No |
| bis(2-Chloroisopropyl) ether | 340 | - | 11000 | 96 | 59,301 | No |
| Bromobenzene | 1.108 | - | 5.9 | 8 | N/A | N/A |
| Bromochloromethane | 1.18 | - | 5.9 | 8 | N/A | N/A |
| Bromodichloromethane | 0.694 | - | 28 | 32 | 67,070 | No |
| Bromoform | 1.127 | - | 28 | 32 | 419,858 | No |
| Bromomethane | 1.618 | - | 57 | 32 | 20,959 | No |
| Butylbenzylphthalate[b] | 340 | - | 1000 | 109 | 1.60E+07 | No |
| Carbon Disulfide | 2.801 | - | 28 | 32 | 1.64E+06 | No |
| Carbon Tetrachloride | 1.19 | - | 28 | 32 | 8,446 | No |
| Chlorobenzene | 1.002 | - | 28 | 32 | 666,523 | No |
| Chloroethane | 3.943 | - | 57 | 32 | 1.43E+06 | No |
| Chloroform | 0.906 | - | 28 | 32 | 7,850 | No |
| Chloromethane | 1.415 | - | 57 | 32 | 115,077 | No |
| cis-1,2-Dichloroethene | 1.073 | - | 2.9 | 8 | 1.11E+06 | No |
| cis-1,3-Dichloropropene | 0.884 | - | 28 | 32 | 19,432 | No |
| delta-BHC | 1.8 | - | 85 | 112 | 570 | No |
| **Dibenz(a,h)anthracene[b]** | **21** | **-** | **1000** | **99** | **379** | **Yes** |
| Dibromochloromethane | 0.737 | - | 28 | 32 | 49,504 | No |
| Dibromomethane | 0.77 | - | 5.9 | 8 | N/A | N/A |
| Dichlorodifluoromethane | 1.942 | - | 5.9 | 6 | 229,820 | No |
| Dieldrin[b] | 3.6 | - | 170 | 111 | 187 | No |
| Diethylphthalate[b] | 340 | - | 1000 | 112 | 6.41E+07 | No |
| Dimethylphthalate | 340 | - | 1000 | 112 | 8.01E+08 | No |
| Di-n-octylphthalate[b] | 340 | - | 1000 | 109 | 3.21E+06 | No |
| Endosulfan I | 1.8 | - | 85 | 112 | 480,861 | No |
| Endosulfan II | 3.6 | - | 92 | 106 | 480,861 | No |
| Endosulfan sulfate[b] | 3.6 | - | 170 | 111 | 480,861 | No |
| Endrin | 3.6 | - | 200 | 112 | 24,043 | No |
| Endrin aldehyde | 3.6 | - | 11 | 6 | 24,043 | No |

**Table A1.1**

**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil/Surface Sediment**

| Analyte | Range of Reported Results | | | Total Number of Results | PRG | Maximum Result > PRG?[a] |
|---|---|---|---|---|---|---|
| Endrin ketone[b] | 3.6 | - | 170 | 111 | 33,326 | No |
| Ethylbenzene | 1.077 | - | 28 | 32 | 5.39E+06 | No |
| gamma-BHC (Lindane) | 1.8 | - | 85 | 112 | 2,771 | No |
| gamma-Chlordane | 100 | - | 220 | 12 | 10,261 | No |
| Heptachlor | 1.8 | - | 85 | 112 | 665 | No |
| Heptachlor epoxide[b] | 1.8 | - | 85 | 111 | 329 | No |
| Hexachlorobenzene | 340 | - | 1000 | 109 | 1,870 | No |
| Hexachlorobutadiene | 1.256 | - | 1000 | 118 | 22,217 | No |
| Hexachlorocyclopentadiene | 340 | - | 1000 | 106 | 380,452 | No |
| Hexachloroethane | 340 | - | 1000 | 112 | 111,087 | No |
| Isophorone[b] | 270 | - | 1000 | 111 | 3.16E+06 | No |
| Isopropylbenzene | 1.31 | - | 5.9 | 8 | 32,680 | No |
| Methoxychlor[b] | 18 | - | 850 | 111 | 400,718 | No |
| n-Butylbenzene | 1.045 | - | 5.9 | 8 | N/A | N/A |
| Nitrobenzene | 340 | - | 1000 | 109 | 43,246 | No |
| N-Nitroso-di-n-propylamine | 340 | - | 1000 | 112 | 429 | Yes |
| N-nitrosodiphenylamine | 340 | - | 1000 | 112 | 612,250 | No |
| n-Propylbenzene | 1.163 | - | 5.9 | 8 | N/A | N/A |
| Aroclor-1016 | 34 | - | 850 | 114 | 1,349 | No |
| Aroclor-1221 | 34 | - | 850 | 114 | 1,349 | No |
| Aroclor-1232 | 34 | - | 850 | 114 | 1,349 | No |
| Aroclor-1242 | 34 | - | 850 | 114 | 1,349 | No |
| Aroclor-1248 | 34 | - | 850 | 114 | 1,349 | No |
| **Aroclor-1260[b]** | **36** | **-** | **1700** | **112** | **1,349** | **Yes** |
| Pentachlorophenol | 900 | - | 4900 | 79 | 17,633 | No |
| Phenol[b] | 340 | - | 1000 | 77 | 2.40E+07 | No |
| Pyridine | 740 | - | 750 | 2 | N/A | N/A |
| sec-Butylbenzene | 1.102 | - | 5.9 | 8 | N/A | N/A |
| Styrene | 1.058 | - | 28 | 32 | 1.38E+07 | No |
| tert-Butylbenzene | 1.151 | - | 5.9 | 8 | N/A | N/A |
| Toxaphene | 110 | - | 1700 | 112 | 2,720 | No |
| trans-1,2-Dichloroethene | 1.408 | - | 2.9 | 8 | 287,340 | No |
| trans-1,3-Dichloropropene | 0.945 | - | 28 | 32 | 20,820 | No |
| Trichloroethene[b] | 0.67 | - | 28 | 32 | 1,770 | No |
| Trichlorofluoromethane | 1.317 | - | 5.9 | 8 | 1.51E+06 | No |
| Vinyl acetate | 11 | - | 57 | 19 | 2.65E+06 | No |
| Vinyl Chloride | 2.971 | - | 57 | 32 | 2,169 | No |

[a] Value is the maximum reported result for nondetected analytes.

[b] The analyte has a detection frequency of less than 5%

**Bold = Maximum result greater than PRG.**

N/A = Not available.

UT = Uncertain toxicity.

**Table A1.2**
**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil/Subsurface Sediment**

| Analyte | Range of Reported Results | | | Total Number of Result | PRG | Maximum Result > PRG?[a] |
|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)** | | | | | | |
| Nitrate / Nitrite | 2.2 | - | 2.2 | 1 | 2.04E+06 | No |
| **Organics (ug/kg)** | | | | | | |
| 1,1,1,2-Tetrachloroethane | 1.275 | - | 1.462 | 8 | 1.05E+06 | No |
| 1,1,1-Trichloroethane[b] | 1.131 | - | 31 | 196 | 1.06E+08 | No |
| 1,1,2,2-Tetrachloroethane | 0.995 | - | 31 | 195 | 120,551 | No |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 1.009 | - | 2.208 | 8 | 2.74E+10 | No |
| 1,1,2-Trichloroethane | 0.958 | - | 31 | 199 | 322,253 | No |
| 1,1-Dichloroethane | 1.016 | - | 31 | 199 | 3.12E+07 | No |
| 1,1-Dichloroethene | 1.527 | - | 31 | 199 | 199,706 | No |
| 1,1-Dichloropropene | 1.297 | - | 1.488 | 8 | N/A | N/A |
| 1,2,3-Trichlorobenzene | 0.724 | - | 1.685 | 8 | N/A | N/A |
| 1,2,3-Trichloropropane | 1.069 | - | 1.226 | 8 | 23,910 | No |
| 1,2,4-Trichlorobenzene[b] | 1.001 | - | 7700 | 111 | 1.74E+06 | No |
| 1,2,4-Trimethylbenzene | 1.051 | - | 1.205 | 8 | 1.53E+06 | No |
| 1,2-Dibromo-3-chloropropane | 1.86 | - | 3.149 | 8 | 34,137 | No |
| 1,2-Dibromoethane | 0.848 | - | 1.318 | 8 | 403 | No |
| 1,2-Dichlorobenzene[b] | 0.755 | - | 7700 | 111 | 3.32E+07 | No |
| 1,2-Dichloroethane | 1.03 | - | 31 | 199 | 152,603 | No |
| 1,2-Dichloroethene | 5 | - | 31 | 188 | 1.15E+07 | No |
| 1,2-Dichloropropane | 0.884 | - | 31 | 199 | 441,907 | No |
| 1,3,5-Trimethylbenzene | 0.733 | - | 1.005 | 8 | 1.31E+06 | No |
| 1,3-Dichlorobenzene[b] | 1.053 | - | 7700 | 111 | 3.83E+07 | No |
| 1,3-Dichloropropane | 0.598 | - | 0.933 | 8 | N/A | N/A |
| 1,4-Dichlorobenzene[b] | 1.142 | - | 7700 | 111 | 1.05E+06 | No |
| 2,2-Dichloropropane | 1.047 | - | 1.232 | 8 | N/A | N/A |
| 2,4,5-Trichlorophenol | 740 | - | 37000 | 108 | 9.22E+07 | No |
| 2,4,6-Trichlorophenol | 340 | - | 7700 | 108 | 3.13E+06 | No |
| 2,4-Dichlorophenol | 340 | - | 7700 | 108 | 2.76E+06 | No |
| 2,4-Dimethylphenol | 340 | - | 7700 | 108 | 1.84E+07 | No |
| 2,4-Dinitrophenol | 1700 | - | 37000 | 95 | 1.84E+06 | No |
| 2,4-Dinitrotoluene | 340 | - | 7700 | 108 | 1.84E+06 | No |
| 2,6-Dinitrotoluene | 340 | - | 7700 | 108 | 921,651 | No |
| 2-Butanone[b] | 10 | - | 62 | 171 | 5.33E+08 | No |
| 2-Chloronaphthalene | 340 | - | 7700 | 108 | 7.37E+07 | No |
| 2-Chlorophenol[b] | 340 | - | 7700 | 107 | 6.39E+06 | No |
| 2-Chlorotoluene | 1.627 | - | 1.867 | 8 | 2.56E+07 | No |
| 2-Hexanone | 8.238 | - | 62 | 187 | N/A | N/A |
| 2-Methylphenol | 340 | - | 7700 | 108 | 4.61E+07 | No |
| 2-Nitroaniline | 1700 | - | 37000 | 108 | 2.21E+06 | No |
| 2-Nitrophenol | 340 | - | 7700 | 108 | N/A | N/A |
| 3,3'-Dichlorobenzidine[b] | 690 | - | 15000 | 106 | 76,667 | No |
| 3-Nitroaniline | 1700 | - | 37000 | 95 | N/A | N/A |
| 4,4'-DDD | 9.4 | - | 42 | 100 | 178,570 | No |
| 4,4'-DDE | 9.4 | - | 42 | 97 | 126,049 | No |
| 4,4'-DDT | 9.4 | - | 42 | 100 | 125,658 | No |
| 4,6-Dinitro-2-methylphenol | 1700 | - | 37000 | 107 | 92,165 | No |
| 4-Bromophenyl-phenylether | 340 | - | 7700 | 108 | N/A | N/A |
| 4-Chloro-3-methylphenol[b] | 340 | - | 7700 | 107 | N/A | N/A |
| 4-Chloroaniline | 340 | - | 7700 | 95 | 3.69E+06 | No |

**Table A1.2**

**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil/Subsurface Sediment**

| Analyte | Range of Reported Results | | | Total Number of Result | PRG | Maximum Result > PRG? |
|---|---|---|---|---|---|---|
| 4-Chlorophenyl-phenyl ether | 340 | - | 7700 | 108 | N/A | N/A |
| 4-Chlorotoluene | 0.954 | - | 1.094 | 8 | N/A | N/A |
| 4-Isopropyltoluene | 1.121 | - | 1.378 | 8 | N/A | N/A |
| 4-Methyl-2-pentanone[b] | 6.964 | - | 62 | 189 | 9.57E+08 | No |
| 4-Methylphenol | 340 | - | 7700 | 108 | 4.61E+06 | No |
| 4-Nitroaniline | 1700 | - | 37000 | 95 | 2.39E+06 | No |
| 4-Nitrophenol | 1700 | - | 37000 | 105 | 7.37E+06 | No |
| Acenaphthylene[b] | 340 | - | 7700 | 107 | N/A | N/A |
| Aldrin | 4.7 | - | 21 | 100 | 2,024 | No |
| alpha-BHC[b] | 4.7 | - | 21 | 99 | 6,555 | No |
| alpha-Chlordane | 47 | - | 210 | 100 | 117,997 | No |
| Aroclor-1016 | 47 | - | 210 | 100 | 15,514 | No |
| Aroclor-1221 | 47 | - | 210 | 100 | 15,514 | No |
| Aroclor-1232 | 47 | - | 210 | 97 | 15,514 | No |
| Aroclor-1242 | 47 | - | 210 | 100 | 15,514 | No |
| Aroclor-1248 | 47 | - | 210 | 100 | 15,514 | No |
| Aroclor-1260[b] | 94 | - | 420 | 97 | 15,514 | No |
| Benzene | 0.84 | - | 31 | 199 | 270,977 | No |
| Benzyl Alcohol | 340 | - | 7700 | 100 | 2.76E+08 | No |
| beta-BHC | 4.7 | - | 21 | 100 | 22,942 | No |
| beta-Chlordane | 47 | - | 200 | 94 | 117,997 | No |
| bis(2-Chloroethoxy) methane | 340 | - | 7700 | 108 | N/A | N/A |
| bis(2-Chloroethyl) ether | 340 | - | 7700 | 108 | 43,315 | No |
| bis(2-Chloroisopropyl) ether | 340 | - | 7700 | 107 | 681,967 | No |
| Bromobenzene | 1.125 | - | 1.537 | 8 | N/A | N/A |
| Bromochloromethane | 1.198 | - | 1.473 | 8 | N/A | N/A |
| Bromodichloromethane | 0.705 | - | 31 | 199 | 771,304 | No |
| Bromoform[b] | 1.144 | - | 31 | 193 | 4.83E+06 | No |
| Bromomethane | 1.643 | - | 62 | 185 | 241,033 | No |
| Butylbenzylphthalate[b] | 340 | - | 7700 | 103 | 1.84E+08 | No |
| Carbon Disulfide | 2.844 | - | 31 | 195 | 1.88E+07 | No |
| Carbon Tetrachloride | 1.209 | - | 31 | 197 | 97,124 | No |
| Chlorobenzene | 1.017 | - | 31 | 199 | 7.67E+06 | No |
| Chloroethane | 4.003 | - | 62 | 188 | 1.65E+07 | No |
| Chloroform | 0.92 | - | 31 | 199 | 90,270 | No |
| Chloromethane | 1.437 | - | 62 | 196 | 1.32E+06 | No |
| cis-1,3-Dichloropropene | 0.898 | - | 31 | 199 | 223,462 | No |
| delta-BHC | 4.7 | - | 21 | 100 | 6,555 | No |
| Dibromochloromethane | 0.748 | - | 31 | 199 | 569,296 | No |
| Dibromomethane | 0.782 | - | 1.299 | 8 | N/A | N/A |
| Dichlorodifluoromethane | 1.953 | - | 3.185 | 8 | 2.64E+06 | No |
| Dieldrin | 9.4 | - | 42 | 96 | 2,151 | No |
| Diethylphthalate[b] | 340 | - | 7700 | 106 | 7.37E+08 | No |
| Dimethylphthalate | 340 | - | 7700 | 108 | 9.22E+09 | No |
| Di-n-octylphthalate[b] | 340 | - | 7700 | 106 | 3.69E+07 | No |
| Endosulfan I | 4.7 | - | 21 | 99 | 5.53E+06 | No |
| Endosulfan II | 9.4 | - | 42 | 98 | 5.53E+06 | No |
| Endosulfan sulfate | 9.4 | - | 42 | 97 | 5.53E+06 | No |
| Endrin | 9.4 | - | 42 | 96 | 276,495 | No |
| Endrin ketone | 9.4 | - | 42 | 100 | 383,250 | No |
| Ethylbenzene | 0.896 | - | 31 | 199 | 6.19E+07 | No |

**Table A1.2**

**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil/Subsurface Sediment**

| Analyte | Range of Reported Results | | | Total Number of Result | PRG | Maximum Result[a] > PRG? |
|---|---|---|---|---|---|---|
| gamma-BHC (Lindane) | 4.7 | - | 21 | 100 | 31,864 | No |
| gamma-Chlordane | 160 | - | 210 | 6 | 117,997 | No |
| Heptachlor[b] | 4.7 | - | 21 | 99 | 7,647 | No |
| Heptachlor epoxide[b] | 4.7 | - | 21 | 99 | 3,782 | No |
| Hexachlorobenzene[b] | 340 | - | 7700 | 107 | 21,508 | No |
| Hexachlorobutadiene | 1.275 | - | 7700 | 112 | 255,500 | No |
| Hexachlorocyclopentadiene | 340 | - | 7700 | 105 | 4.38E+06 | No |
| Hexachloroethane | 340 | - | 7700 | 108 | 1.28E+06 | No |
| Isophorone[b] | 340 | - | 7700 | 107 | 3.63E+07 | No |
| Isopropylbenzene | 1.33 | - | 1.525 | 8 | 375,823 | No |
| Methoxychlor | 47 | - | 210 | 100 | 4.61E+06 | No |
| n-Butylbenzene | 1.061 | - | 1.217 | 8 | N/A | N/A |
| Nitrobenzene | 340 | - | 7700 | 108 | 497,333 | No |
| **N-Nitroso-di-n-propylamine** | **340** | **-** | **7700** | **108** | **4,929** | **Yes** |
| N-nitrosodiphenylamine | 340 | - | 7700 | 108 | 7.04E+06 | No |
| n-Propylbenzene | 1.18 | - | 1.354 | 8 | N/A | N/A |
| Pentachlorophenol[b] | 1700 | - | 37000 | 107 | 202,777 | No |
| Phenol[b] | 340 | - | 7700 | 104 | 2.76E+08 | No |
| Pyridine | 740 | - | 840 | 4 | N/A | N/A |
| sec-Butylbenzene | 1.119 | - | 1.283 | 8 | N/A | N/A |
| Styrene | 1.074 | - | 31 | 199 | 1.59E+08 | No |
| tert-Butylbenzene | 1.169 | - | 1.341 | 8 | N/A | N/A |
| Toxaphene | 94 | - | 420 | 100 | 31,284 | No |
| trans-1,2-Dichloroethene | 1.429 | - | 6 | 11 | 3.30E+06 | No |
| trans-1,3-Dichloropropene | 0.959 | - | 31 | 198 | 239,434 | No |
| Trichlorofluoromethane | 1.337 | - | 1.534 | 8 | 1.74E+07 | No |
| Vinyl acetate | 10 | - | 62 | 182 | 3.04E+07 | No |
| Vinyl Chloride | 3.016 | - | 62 | 199 | 24,948 | No |
| Xylene[c] | 2.679 | - | 31 | 199 | 1.22E+07 | No |

[a] Value is the maximum reported result for nondetected analytes.

[b] The analyte has a detection frequency of less than 5%

[c] The value for total xylene is used.

**Bold = Maximum result greater than PRG.**

N/A = Not available.

UT = Uncertain toxicity.

**Table A1.3**
**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil**

| Analyte | Range of Reported Results | | | Total Number of Result | Lowest ESL | Maximum Result > ESL?[a] |
|---|---|---|---|---|---|---|
| **Organics (ug/kg)** | | | | | | |
| 1,1,1,2-Tetrachloroethane | 1.256 | - | 5.9 | 8 | N/A | N/A |
| 1,1,1-Trichloroethane | 1.114 | - | 28 | 11 | 551,453 | No |
| 1,1,2,2-Tetrachloroethane | 0.98 | - | 28 | 11 | 60,701 | No |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 0.993 | - | 5.9 | 8 | N/A | N/A |
| 1,1,2-Trichloroethane | 0.944 | - | 28 | 11 | N/A | N/A |
| 1,1-Dichloroethane | 1.001 | - | 28 | 11 | 3,121 | No |
| 1,1-Dichloroethene | 1.504 | - | 28 | 11 | 16,909 | No |
| 1,1-Dichloropropene | 1.277 | - | 5.9 | 8 | N/A | N/A |
| 1,2,3-Trichlorobenzene | 0.713 | - | 5.9 | 8 | N/A | N/A |
| 1,2,3-Trichloropropane | 1.053 | - | 5.9 | 8 | 13,883 | No |
| **1,2,4-Trichlorobenzene[b]** | **0.986** | **-** | **960** | **94** | **777** | **Yes** |
| 1,2-Dibromo-3-chloropropane | 1.832 | - | 5.9 | 8 | N/A | N/A |
| 1,2-Dibromoethane | 0.836 | - | 5.9 | 8 | N/A | N/A |
| 1,2-Dichlorobenzene | 0.744 | - | 960 | 95 | N/A | N/A |
| 1,2-Dichloroethane | 1.014 | - | 28 | 11 | 2,764 | No |
| 1,2-Dichloroethene | 11 | - | 28 | 3 | 25,617 | No |
| 1,2-Dichloropropane | 0.871 | - | 28 | 11 | 49,910 | No |
| 1,3,5-Trimethylbenzene | 0.99 | - | 5.9 | 8 | 7,598 | No |
| 1,3-Dichlorobenzene | 1.037 | - | 960 | 95 | N/A | N/A |
| 1,3-Dichloropropane | 0.589 | - | 5.9 | 8 | N/A | N/A |
| 1,4-Dichlorobenzene | 1.125 | - | 960 | 95 | 20,000 | No |
| 2,2-Dichloropropane | 1.031 | - | 5.9 | 8 | N/A | N/A |
| 2,4,5-Trichlorophenol | 740 | - | 4100 | 56 | 4,000 | Yes |
| 2,4,6-Trichlorophenol | 340 | - | 820 | 56 | 161 | Yes |
| 2,4-Dichlorophenol | 340 | - | 820 | 56 | 2,744 | No |
| 2,4-Dimethylphenol | 340 | - | 820 | 56 | N/A | N/A |
| 2,4-Dinitrophenol | 900 | - | 4100 | 56 | 20,000 | No |
| 2,4-Dinitrotoluene | 340 | - | 960 | 89 | 32.1 | Yes |
| 2,6-Dinitrotoluene | 340 | - | 960 | 89 | 6,186 | No |
| 2-Chloronaphthalene | 340 | - | 960 | 89 | N/A | N/A |
| 2-Chlorophenol | 340 | - | 820 | 56 | 281 | Yes |
| 2-Chlorotoluene | 1.603 | - | 5.9 | 8 | N/A | N/A |
| 2-Hexanone | 8.114 | - | 57 | 11 | N/A | N/A |
| 2-Methylphenol | 340 | - | 820 | 56 | 123,842 | No |
| 2-Nitroaniline | 900 | - | 4600 | 86 | 5,659 | No |
| 2-Nitrophenol | 340 | - | 820 | 56 | N/A | N/A |
| 3,3'-Dichlorobenzidine | 360 | - | 23000 | 66 | N/A | N/A |
| 3-Nitroaniline | 900 | - | 55000 | 71 | N/A | N/A |
| 4,4'-DDD | 3.6 | - | 170 | 89 | 13,726 | No |
| 4,4'-DDE | 3.6 | - | 170 | 89 | 7.95 | Yes |
| **4,4'-DDT[b]** | **3.6** | **-** | **170** | **88** | **1.20** | **Yes** |
| 4,6-Dinitro-2-methylphenol | 900 | - | 4100 | 56 | 560 | Yes |
| 4-Bromophenyl-phenylether | 340 | - | 960 | 89 | N/A | N/A |
| 4-Chloro-3-methylphenol | 340 | - | 1500 | 56 | N/A | N/A |
| 4-Chloroaniline | 340 | - | 11000 | 80 | 716 | Yes |
| 4-Chlorophenyl-phenyl ether | 340 | - | 960 | 89 | N/A | N/A |
| 4-Chlorotoluene | 0.94 | - | 5.9 | 8 | N/A | N/A |
| 4-Isopropyltoluene | 1.104 | - | 5.9 | 8 | N/A | N/A |
| 4-Methylphenol | 340 | - | 820 | 56 | N/A | N/A |
| 4-Nitroaniline | 900 | - | 55000 | 80 | 41,050 | Yes |

**Table A1.3**

**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil**

| Analyte | Range of Reported Results | | | Total Number of Result | Lowest ESL | Maximum Result > ESL?[a] |
|---|---|---|---|---|---|---|
| 4-Nitrophenol | 900 | - | 4100 | 46 | 7,000 | No |
| Acenaphthylene[b] | 340 | - | 2300 | 102 | N/A | N/A |
| **Aldrin[b]** | **1.8** | **-** | **85** | **88** | **47.0** | **Yes** |
| alpha-BHC | 1.8 | - | 85 | 89 | 18,662 | No |
| alpha-Chlordane | 1.8 | - | 850 | 88 | 289 | Yes |
| Aroclor-1016 | 34 | - | 850 | 90 | 172 | Yes |
| Aroclor-1221 | 34 | - | 850 | 90 | 172 | Yes |
| Aroclor-1232 | 34 | - | 850 | 90 | 172 | Yes |
| Aroclor-1242 | 34 | - | 850 | 90 | 172 | Yes |
| Aroclor-1248 | 34 | - | 850 | 90 | 172 | Yes |
| **Aroclor-1260[b]** | **36** | **-** | **1700** | **88** | **172** | **Yes** |
| Benzyl Alcohol[b] | 340 | - | 1500 | 47 | 4,403 | No |
| beta-BHC | 1.8 | - | 85 | 88 | 207 | No |
| beta-Chlordane | 1.8 | - | 850 | 84 | 289 | Yes |
| bis(2-Chloroethoxy) methane | 340 | - | 960 | 89 | N/A | N/A |
| bis(2-Chloroethyl) ether | 340 | - | 960 | 89 | N/A | N/A |
| bis(2-Chloroisopropyl) ether | 340 | - | 11000 | 74 | N/A | N/A |
| Bromobenzene | 1.108 | - | 5.9 | 8 | N/A | N/A |
| Bromochloromethane | 1.18 | - | 5.9 | 8 | N/A | N/A |
| Bromodichloromethane | 0.694 | - | 28 | 11 | 5,750 | No |
| Bromoform | 1.127 | - | 28 | 11 | 2,855 | No |
| Bromomethane | 1.618 | - | 57 | 11 | N/A | N/A |
| Butylbenzylphthalate[b] | 340 | - | 960 | 87 | 24,155 | No |
| Carbon Disulfide | 2.801 | - | 28 | 11 | 5,676 | No |
| Carbon Tetrachloride | 1.19 | - | 28 | 11 | 8,906 | No |
| Chlorobenzene | 1.002 | - | 28 | 11 | 4,750 | No |
| Chloroethane | 3.943 | - | 57 | 11 | N/A | N/A |
| Chloroform | 0.906 | - | 28 | 11 | 8,655 | No |
| Chloromethane | 1.415 | - | 57 | 11 | N/A | N/A |
| cis-1,2-Dichloroethene | 1.073 | - | 2.9 | 8 | 1,814 | No |
| cis-1,3-Dichloropropene | 0.884 | - | 28 | 11 | 2,800 | No |
| delta-BHC | 1.8 | - | 85 | 89 | 25.9 | Yes |
| Dibromochloromethane | 0.737 | - | 28 | 11 | 5,730 | No |
| Dibromomethane | 0.77 | - | 5.9 | 8 | N/A | N/A |
| Dichlorodifluoromethane | 1.942 | - | 5.9 | 6 | 855 | No |
| **Dieldrin[b]** | **3.6** | **-** | **170** | **88** | **7.40** | **Yes** |
| Diethylphthalate | 340 | - | 960 | 89 | 100,000 | No |
| Dimethylphthalate | 340 | - | 960 | 89 | 200,000 | No |
| Di-n-octylphthalate[b] | 340 | - | 960 | 87 | 731,367 | No |
| Endosulfan I | 1.8 | - | 85 | 89 | 80.1 | Yes |
| Endosulfan II | 3.6 | - | 92 | 83 | 80.1 | Yes |
| **Endosulfan sulfate[b]** | **3.6** | **-** | **170** | **88** | **80.1** | **Yes** |
| Endrin | 3.6 | - | 200 | 89 | 1.40 | Yes |
| Endrin aldehyde | 3.6 | - | 3.6 | 2 | 1.40 | Yes |
| **Endrin ketone[b]** | **3.6** | **-** | **170** | **88** | **1.40** | **Yes** |
| Ethylbenzene | 1.077 | - | 28 | 11 | N/A | N/A |
| gamma-BHC (Lindane) | 1.8 | - | 85 | 89 | 25.9 | Yes |
| gamma-Chlordane | 180 | - | 220 | 5 | 289 | No |
| Heptachlor | 1.8 | - | 85 | 89 | 63.3 | Yes |

**Table A1.3**

**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil**

| Analyte | Range of Reported Results | | | Total Number of Result | Lowest ESL | Maximum Result > ESL?[a] |
|---|---|---|---|---|---|---|
| **Heptachlor epoxide[b]** | **1.8** | **-** | **85** | **88** | **64.0** | **Yes** |
| Hexachlorobenzene | 340 | - | 960 | 86 | 7.73 | Yes |
| Hexachlorobutadiene | 1.256 | - | 960 | 95 | 431 | Yes |
| Hexachlorocyclopentadiene | 340 | - | 960 | 83 | 5,518 | No |
| Hexachloroethane | 340 | - | 960 | 89 | 366 | Yes |
| Isophorone[b] | 340 | - | 960 | 88 | N/A | N/A |
| Isopropylbenzene | 1.31 | - | 5.9 | 8 | N/A | N/A |
| Methoxychlor[b] | 18 | - | 850 | 88 | 1,226 | No |
| n-Butylbenzene | 1.045 | - | 5.9 | 8 | N/A | N/A |
| Nitrobenzene | 340 | - | 960 | 86 | 40,000 | No |
| N-Nitroso-di-n-propylamine | 340 | - | 960 | 89 | N/A | N/A |
| N-nitrosodiphenylamine | 340 | - | 960 | 89 | 20,000 | No |
| n-Propylbenzene | 1.163 | - | 5.9 | 8 | N/A | N/A |
| **Pentachlorophenol** | **900** | **-** | **4100** | **56** | **122** | **Yes** |
| Phenol[b] | 340 | - | 820 | 54 | 23,090 | No |
| Pyridine | 740 | - | 750 | 2 | N/A | N/A |
| sec-Butylbenzene | 1.102 | - | 5.9 | 8 | N/A | N/A |
| Styrene | 1.058 | - | 28 | 11 | 16,408 | No |
| tert-Butylbenzene | 1.151 | - | 5.9 | 8 | N/A | N/A |
| Toxaphene | 110 | - | 1700 | 89 | 3,756 | No |
| trans-1,2-Dichloroethene | 1.408 | - | 2.9 | 8 | 25,617 | No |
| trans-1,3-Dichloropropene | 0.945 | - | 28 | 11 | 2,800 | No |
| Trichloroethene | 0.67 | - | 28 | 11 | 389 | No |
| Trichlorofluoromethane | 1.317 | - | 5.9 | 8 | N/A | N/A |
| Vinyl acetate | 57 | - | 57 | 1 | 13,986 | No |
| Vinyl Chloride | 2.971 | - | 57 | 11 | 97.7 | No |

[a] Value is the maximum reported result for nondetected analytes.

[b] The analyte has a detection frequency of less than 5%

**Bold = Maximum result greater than PRG.**

N/A = Not available.

UT = Uncertain toxicity.

## Table A1.4
**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil**

| Analyte | Range of Reported Results | | | Total Number of Result | Lowest ESL | Maximum Result > ESL?[a] |
|---|---|---|---|---|---|---|
| **Organics (ug/kg)** | | | | | | |
| 1,1,1,2-Tetrachloroethane | 1.275 | - | 1.462 | 8 | N/A | N/A |
| 1,1,1-Trichloroethane[b] | 1.131 | - | 31 | 195 | 4.85E+07 | No |
| 1,1,2,2-Tetrachloroethane | 0.995 | - | 31 | 194 | 4.70E+06 | No |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 1.009 | - | 2.208 | 8 | N/A | N/A |
| 1,1,2-Trichloroethane | 0.958 | - | 31 | 198 | N/A | N/A |
| 1,1-Dichloroethane | 1.016 | - | 31 | 198 | 215,360 | No |
| 1,1-Dichloroethene | 1.527 | - | 31 | 198 | 1.28E+06 | No |
| 1,1-Dichloropropene | 1.297 | - | 1.488 | 8 | N/A | N/A |
| 1,2,3-Trichlorobenzene | 0.724 | - | 1.685 | 8 | N/A | N/A |
| 1,2,3-Trichloropropane | 1.069 | - | 1.226 | 8 | 1.17E+06 | No |
| 1,2,4-Trichlorobenzene[b] | 1.001 | - | 7700 | 110 | 94,484 | No |
| 1,2,4-Trimethylbenzene | 1.051 | - | 1.205 | 8 | N/A | N/A |
| 1,2-Dibromo-3-chloropropane | 1.86 | - | 3.149 | 8 | N/A | N/A |
| 1,2-Dibromoethane | 0.848 | - | 1.318 | 8 | N/A | N/A |
| 1,2-Dichlorobenzene[b] | 0.755 | - | 7700 | 110 | N/A | N/A |
| 1,2-Dichloroethane | 1.03 | - | 31 | 198 | 2.00E+06 | No |
| 1,2-Dichloroethene | 5 | - | 31 | 187 | 1.87E+06 | No |
| 1,2-Dichloropropane | 0.884 | - | 31 | 198 | 3.92E+06 | No |
| 1,3,5-Trimethylbenzene | 0.733 | - | 1.005 | 8 | 855,709 | No |
| 1,3-Dichlorobenzene[b] | 1.053 | - | 7700 | 110 | N/A | N/A |
| 1,3-Dichloropropane | 0.598 | - | 0.933 | 8 | N/A | N/A |
| 1,4-Dichlorobenzene[b] | 1.142 | - | 7700 | 110 | 5.93E+06 | No |
| 2,2-Dichloropropane | 1.047 | - | 1.232 | 8 | N/A | N/A |
| 2,4,5-Trichlorophenol | 740 | - | 37000 | 107 | N/A | N/A |
| 2,4,6-Trichlorophenol | 340 | - | 7700 | 107 | 17,263 | No |
| 2,4-Dichlorophenol | 340 | - | 7700 | 107 | 249,324 | No |
| 2,4-Dimethylphenol | 340 | - | 7700 | 107 | N/A | N/A |
| 2,4-Dinitrophenol | 1700 | - | 37000 | 95 | 4.90E+06 | No |
| **2,4-Dinitrotoluene** | **340** | **-** | **7700** | **107** | **2,473** | **Yes** |
| 2,6-Dinitrotoluene | 340 | - | 7700 | 107 | 477,309 | No |
| 2-Butanone[b] | 10 | - | 62 | 170 | 4.94E+07 | No |
| 2-Chloronaphthalene | 340 | - | 7700 | 107 | N/A | N/A |
| 2-Chlorophenol[b] | 340 | - | 7700 | 106 | 21,598 | No |
| 2-Chlorotoluene | 1.627 | - | 1.867 | 8 | N/A | N/A |
| 2-Hexanone | 8.238 | - | 62 | 186 | N/A | N/A |
| 2-Methylphenol | 340 | - | 7700 | 107 | 9.26E+06 | No |
| 2-Nitroaniline | 1700 | - | 37000 | 107 | 418,475 | No |
| 2-Nitrophenol | 340 | - | 7700 | 107 | N/A | N/A |
| 3,3'-Dichlorobenzidine[b] | 690 | - | 15000 | 105 | N/A | N/A |
| 3-Nitroaniline | 1700 | - | 37000 | 94 | N/A | N/A |
| 4,4'-DDD | 9.4 | - | 42 | 99 | 6.19E+06 | No |
| 4,4'-DDE | 9.4 | - | 42 | 96 | 54,420 | No |
| 4,4'-DDT | 9.4 | - | 42 | 99 | 175,708 | No |
| 4,6-Dinitro-2-methylphenol | 1700 | - | 37000 | 107 | 44,283 | No |
| 4-Bromophenyl-phenylether | 340 | - | 7700 | 107 | N/A | N/A |
| 4-Chloro-3-methylphenol[b] | 340 | - | 7700 | 106 | N/A | N/A |
| 4-Chloroaniline | 340 | - | 7700 | 94 | 48,856 | No |
| 4-Chlorophenyl-phenyl ether | 340 | - | 7700 | 107 | N/A | N/A |

**Table A1.4**
**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil**

| Analyte | Range of Reported Results | | | Total Number of Result | Lowest ESL | Maximum Result ≥ ESL?[a] |
|---|---|---|---|---|---|---|
| 4-Chlorotoluene | 0.954 | - | 1.094 | 8 | N/A | N/A |
| 4-Isopropyltoluene | 1.121 | - | 1.378 | 8 | N/A | N/A |
| 4-Methyl-2-pentanone[b] | 6.964 | - | 62 | 188 | 859,131 | No |
| 4-Methylphenol | 340 | - | 7700 | 107 | N/A | N/A |
| 4-Nitroaniline | 1700 | - | 37000 | 94 | 2.62E+06 | No |
| 4-Nitrophenol | 1700 | - | 37000 | 104 | 1.02E+06 | No |
| Acenaphthylene[b] | 340 | - | 7700 | 106 | N/A | N/A |
| Aldrin | 4.7 | - | 21 | 99 | 11,282 | No |
| alpha-BHC[b] | 4.7 | - | 21 | 98 | 2.47E+06 | No |
| alpha-Chlordane | 47 | - | 210 | 99 | 472,808 | No |
| Aroclor-1016 | 47 | - | 210 | 99 | 37,963 | No |
| Aroclor-1221 | 47 | - | 210 | 99 | 37,963 | No |
| Aroclor-1232 | 47 | - | 210 | 96 | 37,963 | No |
| Aroclor-1242 | 47 | - | 210 | 99 | 37,963 | No |
| Aroclor-1248 | 47 | - | 210 | 99 | 37,963 | No |
| Aroclor-1260[b] | 94 | - | 420 | 96 | 37,963 | No |
| Benzene | 0.84 | - | 31 | 198 | 1.10E+06 | No |
| Benzyl Alcohol | 340 | - | 7700 | 99 | 253,015 | No |
| beta-BHC | 4.7 | - | 21 | 99 | 27,399 | No |
| beta-Chlordane | 47 | - | 200 | 94 | 472,808 | No |
| bis(2-Chloroethoxy) methane | 340 | - | 7700 | 107 | N/A | N/A |
| bis(2-Chloroethyl) ether | 340 | - | 7700 | 107 | N/A | N/A |
| bis(2-Chloroisopropyl) ether | 340 | - | 7700 | 106 | N/A | N/A |
| Bromobenzene | 1.125 | - | 1.537 | 8 | N/A | N/A |
| Bromochloromethane | 1.198 | - | 1.473 | 8 | N/A | N/A |
| Bromodichloromethane | 0.705 | - | 31 | 198 | 381,135 | No |
| Bromoform[b] | 1.144 | - | 31 | 192 | 198,571 | No |
| Bromomethane | 1.643 | - | 62 | 184 | N/A | N/A |
| Butylbenzylphthalate[b] | 340 | - | 7700 | 102 | 3.37E+06 | No |
| Carbon Disulfide | 2.844 | - | 31 | 194 | 410,941 | No |
| Carbon Tetrachloride | 1.209 | - | 31 | 196 | 736,154 | No |
| Chlorobenzene | 1.017 | - | 31 | 198 | 413,812 | No |
| Chloroethane | 4.003 | - | 62 | 187 | N/A | N/A |
| Chloroform | 0.92 | - | 31 | 198 | 560,030 | No |
| Chloromethane | 1.437 | - | 62 | 195 | N/A | N/A |
| cis-1,3-Dichloropropene | 0.898 | - | 31 | 198 | 222,413 | No |
| delta-BHC | 4.7 | - | 21 | 99 | 3,425 | No |
| Dibromochloromethane | 0.748 | - | 31 | 198 | 389,064 | No |
| Dibromomethane | 0.782 | - | 1.299 | 8 | N/A | N/A |
| Dichlorodifluoromethane | 1.953 | - | 3.185 | 8 | 59,980 | No |
| Dieldrin | 9.4 | - | 42 | 95 | 301 | No |
| Diethylphthalate[b] | 340 | - | 7700 | 105 | 2.21E+08 | No |
| Dimethylphthalate | 340 | - | 7700 | 107 | 1.35E+07 | No |
| Di-n-octylphthalate[b] | 340 | - | 7700 | 105 | 2.58E+08 | No |
| Endosulfan I | 4.7 | - | 21 | 98 | 8,726 | No |
| Endosulfan II | 9.4 | - | 42 | 97 | 8,726 | No |
| Endosulfan sulfate | 9.4 | - | 42 | 96 | 8,726 | No |
| Endrin | 9.4 | - | 42 | 95 | 8,060 | No |
| Endrin ketone | 9.4 | - | 42 | 99 | 8,060 | No |

Table A1.4

**Evaluation of Maximum Detection Limits for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil**

| Analyte | Range of Reported Results | | | Total Number of Result | Lowest ESL | Maximum Result >ESL?[a] |
|---|---|---|---|---|---|---|
| Ethylbenzene | 0.896 | - | 31 | 198 | N/A | N/A |
| gamma-BHC (Lindane) | 4.7 | - | 21 | 99 | 3,425 | No |
| gamma-Chlordane | 160 | - | 210 | 5 | 472,808 | No |
| Heptachlor | 4.7 | - | 21 | 99 | 12,359 | No |
| Heptachlor epoxide[b] | 4.7 | - | 21 | 98 | 9,121 | No |
| Hexachlorobenzene[b] | 340 | - | 7700 | 106 | 190,142 | No |
| Hexachlorobutadiene | 1.275 | - | 7700 | 111 | 150,894 | No |
| Hexachlorocyclopentadiene | 340 | - | 7700 | 104 | 799,679 | No |
| Hexachloroethane | 340 | - | 7700 | 107 | 45,656 | No |
| Isophorone[b] | 340 | - | 7700 | 106 | N/A | N/A |
| Isopropylbenzene | 1.33 | - | 1.525 | 8 | N/A | N/A |
| Methoxychlor | 47 | - | 210 | 99 | 228,896 | No |
| n-Butylbenzene | 1.061 | - | 1.217 | 8 | N/A | N/A |
| Nitrobenzene | 340 | - | 7700 | 107 | N/A | N/A |
| N-Nitroso-di-n-propylamine | 340 | - | 7700 | 107 | N/A | N/A |
| N-nitrosodiphenylamine | 340 | - | 7700 | 107 | 2.15E+06 | No |
| n-Propylbenzene | 1.18 | - | 1.354 | 8 | N/A | N/A |
| **Pentachlorophenol[b]** | **1700** | **-** | **37000** | **106** | **18,373** | **Yes** |
| Phenol[b] | 340 | - | 7700 | 103 | 1.49E+06 | No |
| Pyridine | 740 | - | 840 | 4 | N/A | N/A |
| sec-Butylbenzene | 1.119 | - | 1.283 | 8 | N/A | N/A |
| Styrene | 1.074 | - | 31 | 198 | 1.53E+06 | No |
| tert-Butylbenzene | 1.169 | - | 1.341 | 8 | N/A | N/A |
| Toxaphene | 94 | - | 420 | 99 | 909,313 | No |
| trans-1,2-Dichloroethene | 1.429 | - | 6 | 11 | 1.87E+06 | No |
| trans-1,3-Dichloropropene | 0.959 | - | 31 | 197 | 222,413 | No |
| Trichlorofluoromethane | 1.337 | - | 1.534 | 8 | N/A | N/A |
| Vinyl acetate | 10 | - | 62 | 181 | 730,903 | No |
| Vinyl Chloride | 3.016 | - | 62 | 198 | 6,494 | No |
| Xylene[b] | 2.679 | - | 31 | 198 | 111,663 | No |

[a] Value is the maximum reported result for nondetected analytes.

[b] The analyte has a detection frequency of less than 5%

[c] The value for total xylene is used.

**Bold = Maximum result greater than PRG.**

N/A = Not available.

UT = Uncertain toxicity.

# COMPREHENSIVE RISK ASSESSMENT

## UPPER WOMAN DRAINAGE EXPOSURE UNIT

## VOLUME 10: ATTACHMENT 2

### Data Quality Assessment

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ASD | Analytical Services Division |
| CRA | Comprehensive Risk Assessment |
| DER | duplicate error ratio |
| DQA | Data Quality Assessment |
| DQO | data quality objective |
| EPA | U.S. Environmental Protection Agency |
| EPC | exposure point concentration |
| LCS | laboratory control sample |
| MDA | minimum detectable activity |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| PARCC | precision, accuracy, representativeness, completeness, and comparability |
| QC | quality control |
| RFETS | Rocky Flats Environmental Technology Site |
| RI/FS | Remedial Investigation/Feasibility Study |
| RL | reporting limit |
| RPD | relative percent difference |
| SWD | Soil Water Database |
| UWOEU | Upper Woman Drainage Exposure Unit |
| V&V | verification and validation |

# EXECUTIVE SUMMARY

This document provides an assessment of the quality of the data used in the Upper Woman Drainage Exposure Unit (UWOEU) Comprehensive Risk Assessment (CRA). This Data Quality Assessment (DQA) focuses on all elements of quality control (QC), including both laboratory and sample-specific QC data.

Depending on the matrix and analyte group, anywhere from 76 to 100 percent of the UWOEU data have been verified and/or validated by a validator from the Analytical Services Division (ASD) at the Rocky Flats Environmental Technology Site (RFETS) (or from an outside subcontractor) using verification and validation (V&V) guidelines for each analytical method developed for RFETS. V&V data are identified in the RFETS Soil Water Database (SWD) by a data qualifier flag and reason code(s) that provide an explanation for the qualifier flag. All rejected data have been removed from the dataset used in the CRA because the validator has determined the data are unusable. The remaining V&V data have associated qualifier flags indicating that the data are valid, estimated, or undetected, and are used in the CRA. Of the UWOEU V&V data, approximately 13 percent was qualified as estimated and/or undetected. Approximately 3 percent of the data reported as detected by the laboratory were qualified as undetected due to blank contamination. Data qualified as estimated or undetected are a result of various minor laboratory noncompliance issues that are insufficient to render the data unusable.

A review of the UWOEU V&V data indicates that the data meets the data quality objectives (DQOs) outlined in the Final CRA Work Plan and Methodology (K-H 2004) (hereafter referred to as the CRA Methodology). A review of the most common observations found in the V&V data determined that a minimal amount, less than 1 percent, of the non-V&V data may have been qualified if a review had been performed. Based on this DQA, data for the UWOEU are of sufficient quality for use in the CRA.

# 1.0 INTRODUCTION

The Upper Woman Drainage Exposure Unit (UWOEU) Comprehensive Risk Assessment (CRA) for the Rocky Flats Environmental Technology Site (RFETS) has been prepared in accordance with the CRA Methodology. The CRA Methodology was developed jointly with the regulatory agencies using the consultative process, and was approved by the agencies on September 28, 2004. Consistent with the CRA Methodology, data quality was assessed using a standard precision, accuracy, representativeness, completeness, and comparability (PARCC) parameter analysis (EPA 2002). Both laboratory and field quality control (QC) were evaluated for the UWOEU data set.

Although many of the elements of QC that are reviewed in this document affect more than one PARCC parameter, their major impact on data quality is described below:

- Precision, as a measure of agreement among replicate measurements, is determined quantitatively based on the results of replicate laboratory measurements. Precision of the laboratory data was verified through review of:
  - Relative percent differences (RPDs) for laboratory control samples (LCSs) and LCS duplicates compared to the acceptable ranges (analytical precision);
  - RPDs (nonradionuclides) and duplicate error ratios (DERs) (radionuclides) for field sample and field duplicates compared to the acceptable ranges[1] (field precision);
  - RPDs for matrix spike (MS) and matrix spike duplicates (MSDs) compared to acceptable control ranges (matrix precision); and
  - RPDs for primary- and secondary-column analyses (analytical precision).
- Accuracy, as a measure of the distortion of a measurement process that causes error in measuring the true value, is determined quantitatively based on the analysis of samples with a known concentration. Accuracy of the laboratory data was verified through review of:
  - LCS data, calibration verification data, internal standard data, and instrument tune parameters (laboratory accuracy); and
  - Surrogate recoveries, MSs, and sample preparation (sample-specific accuracy).
- Representativeness of the data was verified through review of:

[1] The CRA Methodology states that the overall precision of the data is considered adequate if the RPD between the target and duplicate, at concentrations five times the reporting limit (RL), is less than 35 percent for solids and 20 percent for liquids. The precision adequacy requirement for radiological contaminants is a DER less than 1.96.

- Laboratory blank data;
- Sample preservation/storage;
- Adherence to sample holding times;
- Documentation issues;
- Contract noncompliance issues; and
- Laboratory activities affecting ability to properly identify compounds.

• Completeness is a data adequacy criterion and is addressed in Appendix A, Volume 2 of the Remedial Investigation/Feasibility Study (RI/FS) Report. It refers to the spatial and temporal distribution of the data, and their adequacy for estimating exposure point concentrations (EPCs) for the CRA.

• Comparability of the data was verified through evaluation of:

- Analytical procedures, and whether they were standard U.S. Environmental Protection Agency (EPA)- and RFETS-approved procedures;
- Instrument types and maintenance, sample preparation techniques, and standard units for reporting; and
- MS and surrogate samples, ensuring accuracy within acceptable ranges.

## 2.0 ANALYTICAL DATA

Approximately 167,000 specific analytical records exist in the UWOEU CRA data set, some 88 percent of which (147,363 records) have undergone verification and validation (V&V). The fraction of the data that was verified and/or validated is shown in Table A2.1 by analyte group and matrix. These data were reviewed by validators and their observations and comments are captured in the Soil Water Database (SWD). All of the data that have been flagged due to V&V findings (except "R"-flagged data) and data that have no flags as a result of V&V are used in the UWOEU CRA. The small amount of data that has not undergone V&V is used as provided by the laboratories. The most common errors found during V&V such as transcription errors, calculation errors, and excluded records that were later added by the validator were reviewed to determine the possible effect on non-V&V data. Assuming that the percentage of data qualified as a result of these issues are representative of similar observations in the non-V&V data, less than 1 percent of the entire UWOEU dataset is at risk for such unacknowledged and therefore uncorrected errors.

Data V&V involves an in-depth review of the data packages from the laboratory to assess compliance with contract requirements. In general, data validation includes all of the activities of verification, as well as additional QC checks and review of some raw laboratory instrument data and calculations. After V&V, a data qualifier flag and/or reason code(s) are assigned to the data record (Tables A2.2 and A2.3). The reason codes provide an explanation for the qualifier flag, thereby making it possible to determine which of the PARCC parameters is affected by the observation (Table A2.4). Qualifier flags are discussed in this Data Quality Assessment (DQA) as those V&V flags that note issues in the data. V&V flags "V," "V1," and "1" represent data that were reviewed by validators, but no issues were observed. Eighty-four percent of the V&V data fall into this category. Additional qualifier flags such as "A," "E," and "Z" were also applied. These validation qualifiers are notations that do not indicate estimation or a change in the status of detection. The data are valid and useable as reported by the laboratory. Three percent of the V&V data are represented by these additional qualifier flags. The specific definitions of these additional V&V flags are presented in Table A2.2. Data with noted issues are presented in Table A2.5 and discussed in detail in Section 3.0.

V&V qualifier flags are not specifically addressed in this data assessment, but rather the reason codes associated with the qualifier flags for each analytical record are summarized and evaluated. This approach was chosen because the validator's specific observations (reason codes), and not the qualifier flags, provide the best descriptors of the data quality.

V&V data records contain a field with V&V reason codes (5, 18/52, 200, 99/101/701, and so forth), or the field is null. These reason codes represent observations related to assessment of precision, accuracy, and representativeness. For example, the reason code 110 definition (see Table A2.3) is "LCS recovery criteria were not met," which is an observation related to data accuracy.

Multiple reason codes were routinely applied to a specific sample method/matrix/analyte combination. Therefore, it was necessary to parse out the individual codes to create a table that included a unique record identifier and the associated parsed data V&V reason code (5, 18, 52, 200, 99, 101, 701, and so forth). With this information and the data V&V reason code definitions, the data validator's observations related to this data set can be re-created for each analytical record.

To summarize the reason codes in a logical manner for presentation, it was first necessary to group the reason codes that have slightly different definitions but convey the same meaning. A standardized definition was then applied to the individual reason codes within the group. The grouped reason codes were also assigned a QC category (for example, blanks, calibration, and holding time), and the affected PARCC parameter (Table A2.4). The reason codes were then summarized for each medium and analyte group within each QC category, applying the standardized definition to the summarized codes. The summary is presented in Table A2.5.

Rejected data (data qualifier flag "R"), consisting of approximately 3.5 percent of all V&V data, have been removed from the data used in the UWOEU CRA because the validator has determined the data to be unusable. The fraction of the data that was rejected during validation and/or verification is shown in Table A2.6 by analyte group and matrix.

Finally, evaluating the RPD (DER for radionuclides) between a target sample and the associated field duplicate is not a QC parameter performed during V&V, but is still an important analysis when determining data precision. Because this analysis was not performed during V&V, the target sample/field duplicate RPD and DER calculations were performed separately and are presented in Table A2.7 as the number of exceedances per analyte group/matrix combination. Only those analyte group/matrix combinations having records that met the criteria for calculating an RPD or DER are presented. RPDs and DERs for target sample/field duplicate analyte pairs where one or both of the results are less than five times the RL are not calculated as outlined in the CRA Methodology.

## 3.0 FINDINGS

V&V observations affecting the CRA data set are summarized by analyte group/matrix/QC category/V&V observation in Table A2.5. The detected and nondetected results are summarized separately to give the reader a better idea of the impact on data usability. Only those issues observed in notable percentages (generally greater than 5 percent) of the data are discussed below in further detail. RPDs (DERs for radionuclides) presented in Table A2.7 are only discussed below when RPD (DER for radionuclides) exceedances of control criteria are greater than 10 percent for any give analyte group/matrix combination. Instances of elevated rates (greater than 10 percent) of rejected data are also discussed below.

### 3.1 Dioxins and Furans – Soil

Blank and internal standard issues resulted in data V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low, with the exception of those records qualified due to blank contamination. While the importance of blanks analyses should not be overlooked, it is also important to note that the data were qualified as usable. Although greater than 20 percent of the target sample/field duplicate analyte pairs exceeded RPD criteria, it is important to note that all exceedances were noted in only one sample pair. This is more indicative of the matrix at a particular location than an overall precision issue.

### 3.2 Herbicides – Soil

Calibration, documentation, holding time, internal standard, surrogate, and other issues resulted in data V&V qualifications related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

### 3.3 Herbicides – Water

Calibration, documentation, holding time, and other issues resulted in data V&V qualifications related to this analyte group/matrix combination. The percentage of all qualifications is low and within method expectations.

### 3.4 Metals – Soil

Blank, calibration, documentation, holding time, instrument setup, LCS, matrix, sensitivity, and other observations resulted in data V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low, with the exception of those records qualified due to issues with low LCS and pre-digestion MS recoveries. While the importance of these QC parameters should not be overlooked, it is also important to note that the data were qualified as usable, although estimated.

### 3.5 Metals – Water

Blank, calculation error, calibration, documentation, holding time, instrument setup, LCS, matrix, sample preparation, sensitivity, and other observations resulted in V&V qualifications associated with this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

### 3.6 Polychlorinated Biphenyls – Soil

Documentation, holding time, surrogate, and other issues resulted in data V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

### 3.7 Polychlorinated Biphenyls – Water

Documentation, holding time, and surrogate issues resulted in data V&V observations related to this analyte group/matrix combination. The percentage of observations is low, with the exception of those data qualified due to transcription errors. Transcription errors have no impact on data quality because all issues have previously been evaluated and corrected.

### 3.8 Pesticides – Soil

Calibration, documentation, holding time, internal standard, surrogate, and other issues resulted in data V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

### 3.9 Pesticides – Water

Blank, calibration, documentation, holding time, surrogate, and other issues resulted in V&V qualification related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

## 3.10 Radionuclides – Soil

Blank, calculation error, calibration, documentation, holding time, instrument setup, LCS, matrix, sensitivity, and other observations resulted in V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low, with few exceptions. Insufficient documentation indicates that a complete V&V evaluation may not have been performed, but it is important to note that the data were qualified as usable, although estimated. Transcription errors and validator-calculated minimum detectable activities (MDAs) have no effect on data quality as all issues have previously been evaluated and corrected. While the importance of QC parameters such as blank, LCS, and MS analyses should not be overlooked, it is also important to note that all data associated with these observations were qualified as usable, although estimated.

## 3.11 Radionuclides – Water

Blank, calculation error, calibration, documentation, holding time, instrument setup, LCS, matrix, sample preparation, sensitivity, and other observations resulted in V&V qualifications related to this analyte group/matrix combination. The percentage of observations is low, with few exceptions. Insufficient documentation indicates that a complete V&V evaluation may not have been performed, but it is important to note that the data were qualified as usable, although estimated. Validator-calculated MDAs have no effect on data quality because all issues have previously been evaluated and corrected. While the importance of QC parameters such as blank analyses and continuing calibration verifications should not be overlooked, it is also important to note that all data associated with these observations were qualified as usable, although estimated. Although almost 12 percent of the V&V data for this analyte group/matrix combination were rejected, 77 percent of associated data was validated and/or verified. This leaves less than 3 percent of the data related to this analyte group and matrix that may have been rejected if a review had been performed.

## 3.12 Semi-Volatile Organic Compounds – Soil

Blank, calculation error, calibration, documentation, holding time, internal standard, matrix, surrogate, and other observations resulted in V&V qualifications related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

## 3.13 Semi-Volatile Organic Compounds – Water

Blank, calibration, documentation, holding time, instrument setup, LCS, matrix, sample preparation, surrogate, and other issues resulted in V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

### 3.14 Volatile Organic Compounds – Soil

Blank, calculation error, calibration, confirmation, documentation, holding time, internal standard, matrix, surrogate, and other issues resulted in V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

### 3.15 Volatile Organic Compounds – Water

Blank, calibration, confirmation, documentation, holding time, instrument setup, internal standard, LCS, matrix, sample preparation, sensitivity, surrogate and other issues resulted in V&V observations related to this analyte group/matrix combination. The percentage of observations is low, with few exceptions. The omissions or errors noted in the data package do not impact data quality as the omitted data were not required for V&V. While the importance of observing allowed sample holding times and proper instrument setup should not be overlooked, it is important to note that the data were qualified as usable, although estimated.

### 3.16 Wet Chemistry Parameters – Soil

Blank, documentation, holding time, matrix, and other issues resulted in V&V observations related to this analyte group/matrix combination. While the percentage of several of the observations is high, it is important to note that this analyte group contains numerous general chemistry parameters having little or no impact on site characterization.

### 3.17 Wet Chemistry Parameters – Water

Blank, calculation error, calibration, documentation, holding time, LCS, matrix, sample preparation, and other issues resulted in V&V observations related to this analyte group/matrix combination. The percentage of all observations is low and within method expectations.

## 4.0 CONCLUSIONS

The quality of the laboratory results were evaluated for compliance with the CRA Methodology data quality objectives (DQOs) through an overall review of PARCC parameters.

Of the data used in the UWOEU CRA, approximately 88 percent underwent the V&V process. Of that 88 percent, 84 percent was qualified as having no QC issues, and approximately 13 percent was qualified as estimated or undetected (Table A2.8). The remaining 3 percent of the V&V data are made up of records qualified with additional flags indicating acceptable data such as "A," "E," or "P." Approximately 3 percent of the data reported as detected by the laboratory were flagged as undetected by the validators due to blank contamination (Table A2.9). Data qualified as estimated or undetected indicate some issues with PARCC parameters, but not to a degree sufficient to mark the data unusable. Approximately 3.5 percent of the entire data set was rejected during the V&V process (Table A2.6).

Although many of the elements of QC that are reviewed in this document affect more than one PARCC parameter, the general discussion below summarizes the data quality per the validation reason codes affecting each specific PARCC parameter. Several V&V reason codes have no real impact on data quality because they represent issues that were noted but corrected, or represent observations related to missing documentation that was not required for data assessment. Approximately 13 percent of the UWOEU V&V data were flagged with these "Other" V&V observations.

- Precision, as a measure of agreement among replicate measurements, is determined quantitatively based on the results of replicate laboratory measurements.

  Of the V&V data, approximately 2 percent was noted for observations related to precision. Of that 2 percent, 99 percent was qualified for issues related to sample matrices. Result confirmation and instrument setup observations make up the other 1 percent. No LCS or instrument sensitivity issues related to precision were noted.

  RPDs and DERs for target sample/field duplicate pairs were found to be acceptable for all analyte group/matrix combinations. Overall, the method precision was found to be generally acceptable.

- Accuracy is a measure of the distortion of a measurement process that causes error in the true value.

  Of the V&V data, 29 percent was noted for accuracy-related observations. Of that 29 percent, 78 percent was noted for laboratory practice-related observations, while sample-specific accuracy observations make up the other 22 percent. Although the percentage of data with noted accuracy issues is slightly elevated, it is important to note that most of the data flagged with these accuracy related observations are also flagged as estimated and the CRA is performed with this uncertainty in mind.

  Accuracy was generally acceptable with infrequent performance outside QC limits.

- Representativeness of the data was verified.

  Of the V&V data, approximately 37 percent was noted for observations related to representativeness. Of that 37 percent, 66 percent was qualified for blank observations, 25 percent for failure to observe allowed holding times, 3 percent for documentation issues, 1 percent sensitivity observations, and 4 percent for issues related to sample preparation. Instrument setup, LCS, matrix and other observations make up the other 1 percent of the data qualified for observations related to sample representativeness.

Reportable levels of target analytes were not routinely detected in the laboratory blanks greater than the laboratory RLs except for relatively isolated incidences. Samples were generally stored and preserved properly. Overall, these elements of QC exceedances are indicative of normal laboratory operations and have little impact the sample data as reported.

Sample data are representative of the site conditions at the time of sample collection.

- Comparability of the data was reviewed and no systematic errors were noted.
  - The use of standard EPA- and RFETS-approved analytical procedures;
  - Instrument types and maintenance, sample preparation techniques, and standard units for reporting; and
  - Evaluation of MS and surrogate samples, ensuring accuracy within acceptable ranges.

  Examination of these parameters did not show any systematic issues with comparability.

- Completeness, as defined in the CRA Methodology, is addressed in Appendix A, Volume 2 of the RI/FS Report.

  Another indication of completeness that is sometimes used is a measure of the number of valid measurements obtained in relation to the total number of measurements planned.

  Because less than 4 percent of the overall data were rejected, the use of non-V&V data for the UWOEU CRA does not contribute to any completeness issues.

This review concludes that the PARCC of the data are generally acceptable and the CRA objectives have been met.

## 5.0 REFERENCES

K-H, 2004. Final Comprehensive Risk Assessment Work Plan and Methodology, Environmental Restoration, Rocky Flats Environmental Technology Site, Golden, Colorado. September.

EPA, 2002. Guidance for Quality Assurance Project Plans. EPA QA/G-5, EPA/240/R-02/009. Office of Environmental Information, Washington, D.C. December.

# TABLES

**Table A2.1**
**CRA Data V&V Summary**

| Analyte Group | Matrix | Total No. of V&V Records | Total No. of CRA Records | Percent V&V (%) |
|---|---|---|---|---|
| Dioxins and Furans | SOIL | 187 | 187 | 100.00 |
| Dioxins and Furans | WATER | 14 | 14 | 100.00 |
| Herbicide | SOIL | 173 | 174 | 99.43 |
| Herbicide | WATER | 181 | 239 | 75.73 |
| Metal | SOIL | 11,455 | 11,507 | 99.55 |
| Metal | WATER | 33,908 | 38,967 | 87.02 |
| PCB | SOIL | 1,467 | 1,495 | 98.13 |
| PCB | WATER | 1,050 | 1,155 | 90.91 |
| Pesticide | SOIL | 4,340 | 4,432 | 97.92 |
| Pesticide | WATER | 3,168 | 3,538 | 89.54 |
| Radionuclide | SOIL | 2,842 | 3,155 | 90.08 |
| Radionuclide | WATER | 6,339 | 8,280 | 76.56 |
| SVOC | SOIL | 12,363 | 12,474 | 99.11 |
| SVOC | WATER | 12,210 | 15,623 | 78.15 |
| VOC | SOIL | 8,550 | 9,043 | 94.55 |
| VOC | WATER | 45,430 | 52,048 | 87.28 |
| Wet Chem | SOIL | 94 | 106 | 88.68 |
| Wet Chem | WATER | 3,592 | 4,231 | 84.90 |
| | **Total** | **147,363** | **166,668** | **88.42%** |

**Table A2.2**
**V&V Qualifier Flag Definitions**

| Validation Qualifier Code | Description |
|---|---|
| 1 | QC data from a data package – Verification |
| A | Data acceptable with qualifications |
| B | Compound was found in BLK and sample |
| C | Calibration |
| E | Associated value exceeds calibration range; dilute and reanalyze |
| J | Estimated quantity – Validation |
| J1 | Estimated quantity – Verification |
| JB | Organic method blank contamination – Validation |
| JB1 | Organic method blank contamination – Verification |
| N | Historical – Validators asked not to validate this |
| NJ | Associated value is presumptively estimated |
| NJ1 | Value presumptively estimated – Verification |
| P | Systematic error |
| R | Data unusable – Validation |
| R1 | Data unusable – Verification |
| S | Matrix spike |
| U | Analyzed, not detected at/above method detection limit |
| U1 | Analyzed, not detect at/above method detection limit – Verification |
| UJ | Associated value is considered estimated at an elevated detection |
| UJ1 | Estimated at elevated level – Verification |
| V | No problems with the data – Validation |
| V1 | No problems with the data – Verification |
| Y | Analytical results in validation process |
| Z | Validation was not requested or could not be performed |

**Table A2.3**
**V&V Reason Code Definitions**

| Validation Reason Code | Description |
|---|---|
| *** | Unknown code from RFEDS |
| 1 | Holding times were exceeded |
| 2 | Holding times were grossly exceeded |
| 3 | Initial calibration correlation coefficient <0.995 |
| 4 | Calibration verification criteria were not met |
| 5 | CRDL check sample recovery criteria were not met |
| 6 | Incorrect calibration of instrument |
| 7 | Analyte values > IDL were found in the blanks |
| 8 | Negative bias was indicated in the blanks |
| 9 | Interference indicated in the ICP interference check sample |
| 10 | Laboratory control sample recovery criteria were not met |
| 11 | Duplicate sample precision criteria were not met |
| 12 | Predigestion matrix spike criteria were not met (+/- 25 percent) |
| 13 | Predigestion matrix spike criteria were not met (<30 percent) |
| 14 | Post-digestion matrix spike recovery criteria were not met |
| 15 | MSA was required but not performed |
| 16 | MSA calibration correlation coefficient <0.995 |
| 17 | Serial dilution criteria not met |
| 18 | Documentation was not provided |
| 19 | Calibration verification criteria not met |
| 20 | AA duplicate injection precision criteria were not met |
| 21 | Reagent blanks exceeded MDA |
| 22 | Tracer contamination |
| 23 | Improper aliquot size |
| 24 | Sample aliquot not taken quantitatively |
| 25 | Primary standard had exceeded expiration date |
| 26 | No raw data submitted by the laboratory |
| 27 | Recovery criteria were not met |
| 28 | Duplicate analysis was not performed |
| 29 | Verification criteria were not met |
| 30 | Replicate precision criteria were not met |
| 31 | Replicate analysis was not performed |
| 32 | Laboratory control samples >+/- 3 sigma |
| 33 | Laboratory control samples >+/- 2 sigma and <+/- 3 sigma |
| 35 | Transformed spectral index external ST criteria were not met |
| 36 | MDA exceeded the RDL |
| 37 | Sample exceeded efficiency curve weight limit |
| 38 | Excessive solids on planchet |
| 39 | Tune criteria not met |
| 40 | Organics initial calibration criteria were not met |

**Table A2.3**
**V&V Reason Code Definitions**

| Validation Reason Code | Description |
|---|---|
| 41 | Organics continuing calibration criteria were not met |
| 42 | Surrogates were outside criteria |
| 43 | Internal standards outside criteria |
| 44 | No mass spectra were provided |
| 45 | Results were not confirmed |
| 47 | Percent breakdown exceeded 20 percent |
| 48 | Linear range of instrument was exceeded |
| 49 | Method blank contamination |
| 51 | Nonverifiable laboratory results and/or unsubmitted data |
| 52 | Transcription error |
| 53 | Calculation error |
| 54 | Incorrect reported activity or MDA |
| 55 | Result exceeds linear range; serial dilution value reported |
| 56 | IDL changed due to significant figure discrepancy |
| 57 | Percent solids < 30 percent |
| 58 | Percent solids < 10 percent |
| 59 | Blank activity exceeded RDL |
| 60 | Blank recovery criteria were not met |
| 61 | Replicate recovery criteria were not met |
| 62 | LCS relative percent error criteria not met |
| 63 | LCS expected value not submitted/verifiable |
| 64 | Nontraceable/noncertified standard was used |
| 67 | Sample results not submitted/verifiable |
| 68 | Frequency of quality control samples not met |
| 69 | Samples not distilled |
| 70 | Resolution criteria not met |
| 71 | Unit conversion of results |
| 72 | Calibration counting statistics not met |
| 73 | Daily instrument performance assessment not performed |
| 74 | LCS data not submitted |
| 75 | Blank data not submitted |
| 76 | Instrument gain and/or efficiency not submitted |
| 77 | Detector efficiency criteria not met |
| 78 | MDAs were calculated by reviewer |
| 79 | Result obtained through dilution |
| 80 | Spurious counts of unknown origin |
| 81 | Repeat count outside of 3 sigma counting error |
| 82 | Sample results were not corrected for decay |
| 83 | Sample results were not included on Data Summary Table |
| 84 | Key fields wrong |

## Table A2.3
## V&V Reason Code Definitions

| Validation Reason Code | Description |
|---|---|
| 85 | Record added by QLI |
| 86 | Results considered qualitative not quantitative |
| 87 | Laboratory did no analysis for this record |
| 88 | Blank corrected results |
| 89 | Sample analysis was not requested |
| 90 | Sample result was not validated due to reanalysis |
| 91 | Unit conversion; QC sample activity/uncertainty/MDA |
| 99 | See hard copy for further explanation |
| 101 | Holding times were exceeded (attributed to laboratory problem) |
| 102 | Holding times were grossly exceeded (attribute to laboratory problem) |
| 103 | Calibration correlation coefficient does not meet requirement |
| 104 | Calibration verification recovery criteria were not met |
| 105 | Low-level check sample recovery criteria were not met |
| 106 | Calibration did not contain minimum number of standards |
| 107 | Analyte detected but < RDL in calibration blank verification |
| 109 | Interference indicated in the ICP interference check sample |
| 110 | Laboratory control sample recovery criteria were not met |
| 111 | Laboratory duplicate sample precision criteria were not met |
| 112 | Predigestion matrix spike criteria were not met (+/- 25 percent) |
| 113 | Predigestion matrix spike recovery is <30 percent |
| 114 | Post-digestion matrix spike criteria were not met |
| 115 | MSA was required but not performed |
| 116 | MSA calibration correlation coefficient <0.995 |
| 117 | Serial dilution percent D criteria not met |
| 123 | Improper aliquot size |
| 128 | Laboratory duplicate was not analyzed |
| 129 | Verification criteria for frequency or sequence were not met |
| 130 | Replicate precision criteria were not met |
| 131 | Confirmation percent difference criteria not met |
| 132 | Laboratory control samples >+/- 3 sigma |
| 136 | MDA exceeded the RDL |
| 139 | Tune criteria not met |
| 140 | Requirements for independent calibration verification were not met |
| 141 | Continuing calibration verification criteria were not met |
| 142 | Surrogates were outside criteria |
| 143 | Internal standards outside criteria |
| 145 | Results were not confirmed |
| 147 | Percent breakdown exceeded 20 percent |
| 148 | Linear range of measurement system was exceeded |
| 149 | Method, preparation, or reagent blank contamination > RDL |

**Table A2.3**
**V&V Reason Code Definitions**

| Validation Reason Code | Description |
|---|---|
| 150 | Unknown carrier volume |
| 152 | Reported data do not agree with raw data |
| 153 | Calculation error |
| 155 | Original result exceeds linear range; serial dilution value reported |
| 159 | Magnitude of calibration verification blank result exceeded the RDL |
| 164 | Standard traceability or certification requirements not met |
| 166 | Carrier aliquot nonverifiable |
| 168 | QC sample frequency does not meet requirements |
| 170 | Resolution criteria not met |
| 172 | Calibration counting statistics not met |
| 174 | LCS data not submitted |
| 175 | Blank data not submitted |
| 177 | Detector efficiency criteria not met |
| 188 | Blank corrected results |
| 199 | See hard copy for further explanation |
| 201 | Preservation requirements not met by the laboratory |
| 205 | Unobtainable omissions or errors on SDP (required for databases) |
| 206 | Analyses were not requested according to the SOW |
| 207 | Sample pretreatment or sample preparation method is incorrect |
| 211 | Poor cleanup recovery |
| 212 | Instrument detection limit was not provided |
| 213 | Instrument detection limit is > the associated RDL |
| 214 | IDL is older than 3 months from date of analysis |
| 215 | Blank results were not reported to the IDL/MDL |
| 216 | Post-digestion spike recoveries outside of 85-115 percent criteria |
| 217 | Post-digestion spike recoveries were < 10 percent |
| 218 | Sample COC was not verifiable (attributed to laboratory) |
| 219 | Standards have expired or are not valid |
| 220 | TCLP sample percent solids < 0.5 percent |
| 222 | TCLP particle size was not performed |
| 224 | Incomplete TCLP extraction data |
| 225 | Insufficient TCLP extraction time |
| 226 | TIC misidentification |
| 227 | No documentation regarding deviations from methods or SOW |
| 228 | Calibration recoveries affecting data quality have not been met |
| 229 | Element not analyzed in ICP interference check sample |
| 230 | QC sample/analyte (e.g., spike, duplicate, LCS) not analyzed |
| 231 | MS/MSD criteria not met |
| 232 | Control limits not assigned correctly |
| 233 | Sample matrix QC does not represent samples analyzed |

**Table A2.3**
**V&V Reason Code Definitions**

| Validation Reason Code | Description |
|---|---|
| 234 | QC sample does not meet method requirement |
| 235 | Duplicate sample control limits do not pass |
| 236 | LCS control limits do not pass |
| 237 | Preparation blank control limits do not pass |
| 238 | Blank correction was not performed |
| 239 | Winsorized mean plus standard deviation of the same not calculated or calculated wrong |
| 240 | Sample preparations for soil/sludge/sediment were not homog/aliq properly |
| 241 | No micro PPT or electroplating data available |
| 242 | Tracer requirements were not met |
| 243 | Standard values were not calculated correctly (LCS, tracer, standards) |
| 244 | Standard or tracer is not NIST traceable |
| 245 | Energy calibration criteria not met |
| 246 | Background calibration criteria were not met |
| 247 | Sample or control analysis not chemically separated from each other |
| 248 | Single combined TCLP result was not repeated for sample with both mis+nonm |
| 249 | Result qualified due to blank contamination |
| 250 | Incorrect analysis sequence |
| 251 | Misidentified target compounds |
| 252 | Result is suspect DU |
| 701 | Holding times were exceeded (not attributed to laboratory) |
| 702 | Holding times were grossly exceeded (not attributed to laboratory) |
| 703 | Samples were not preserved properly in the field (not attributed to laboratory) |
| 801 | Missing deliverables (required for data assessment) |
| 802 | Missing deliverables (not required for data assessment) |
| 803 | Omissions or errors on SDP deliverables (required for data assessment) |
| 804 | Omissions or errors on SDP deliverables (not required for data assessment |
| 805 | Information missing from case narrative |
| 806 | Site samples not used for sample matrix QC |
| 807 | Original documentation not provided |
| 808 | Incorrect or incomplete DRC |
| 809 | Non-site samples reported with site samples |
| 810 | EDD does not match hard copy; EDD may be resubmitted |

## Table A2.4
## Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters

| Validation Reason Codes | Standardized Description | QC Category | Affected PARCC Parameter |
|---|---|---|---|
| 188, 88 | Blank corrected results | Blanks | Representativeness |
| 238 | Blank correction was not performed | Blanks | Representativeness |
| 175, 75 | Blank data not submitted | Blanks | Representativeness |
| 60 | Blank recovery criteria were not met | Blanks | Representativeness |
| 215 | Blank results were not reported to the IDL/MDL | Blanks | Representativeness |
| 107, 159 | Calibration verification blank contamination | Blanks | Representativeness |
| 149, 21, 237, 249, 49, 59, 7 | Method, preparation, or reagent blank contamination | Blanks | Representativeness |
| 8 | Negative bias indicated in the blanks | Blanks | Representativeness |
| 153, 53 | Calculation error | Calculation Errors | Other |
| 232 | Control limits not assigned correctly | Calculation Errors | Other |
| 246 | Background calibration criteria were not met | Calibration | Accuracy |
| 103, 3 | Calibration correlation coefficient did not meet requirements | Calibration | Accuracy |
| 172, 72 | Calibration counting statistics did not meet criteria | Calibration | Accuracy |
| 106 | Calibration did not contain minimum number of standards | Calibration | Accuracy |
| 228 | Calibration requirements affecting data quality have not been met | Calibration | Accuracy |
| 104, 141, 19, 29, 4, 40, 41 | Continuing calibration verification criteria were not met | Calibration | Accuracy |
| 245 | Energy calibration criteria not met | Calibration | Accuracy |
| 6 | Incorrect calibration of instrument | Calibration | Accuracy |
| 148, 48 | Result exceeded linear range of measurement system | Calibration | Accuracy |
| 155, 55 | Original result exceeded linear range, serial dilution value reported | Calibration | Accuracy |
| 140 | Requirements for independent calibration verification were not met | Calibration | Accuracy |
| 129 | Frequency or sequencing verification criteria not met | Calibration | Accuracy |
| 131 | Confirmation percent difference criteria not met | Confirmation | Precision |
| 145, 45 | Results were not confirmed | Confirmation | Precision |
| 18 | Sufficient documentation not provided by the laboratory | Documentation issues | Representativeness |
| 705 | Electronic qualifiers were applied from validation report by hand | Documentation issues | Other |
| 805 | Information missing from case narrative | Documentation issues | Other |
| 84 | Key data field incorrect | Documentation issues | Other |
| 802 | Missing deliverables (not required for validation) | Documentation issues | Other |
| 801 | Missing deliverables (required for validation) | Documentation issues | Representativeness |
| 227 | No documentation regarding deviations from methods or SOW | Documentation issues | Other |
| 44 | No mass spectra were provided | Documentation issues | Representativeness |
| 241 | No micro pipette or electroplating data available | Documentation issues | Other |
| 26 | No raw data submitted by the laboratory | Documentation issues | Representativeness |

**Table A2.4**

**Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters**

| Validation Reason Codes | Standardized Description | QC Category | Affected PARCC Parameter |
|---|---|---|---|
| 804 | Omissions or errors in SDP (not required for validation) | Documentation issues | Other |
| 803 | Omissions or errors in SDP (required for validation) | Documentation issues | Representativeness |
| 807 | Original documentation not provided | Documentation issues | Other |
| 85 | Record added by the validator | Documentation issues | Other |
| 152 | Reported data do not agree with raw data | Documentation issues | Other |
| 89 | Sample analysis was not requested | Documentation issues | Other |
| 218 | Sample COC was not verifiable (attributed to laboratory) | Documentation issues | Representativeness |
| 704 | Sample COC was not verifiable (not attributed to laboratory) | Documentation issues | Representativeness |
| 83 | Sample results were not included on Data Summary Table | Documentation issues | Other |
| 52 | Transcription error | Documentation issues | Other |
| 205 | Unobtainable omissions or errors on SDP (required for data assessment) | Documentation issues | Representativeness |
| 1, 101, 701 | Holding times were exceeded | Holding times | Representativeness |
| 2, 102, 702 | Holding times were grossly exceeded | Holding times | Representativeness |
| 251 | Misidentified target compounds | Identification errors | Representativeness |
| 70 | Resolution criteria not met | Identification errors | Representativeness |
| 226 | TIC misidentification | Identification errors | Representativeness |
| 143, 43 | Internal standards did not meet criteria | Internal standards | Accuracy |
| 5 | CRDL check sample recovery criteria were not met | LCS | Accuracy |
| 33 | LCS > ± 2 sigma and < ± 3 sigma | LCS | Accuracy |
| 10, 110, 236 | LCS recovery criteria were not met | LCS | Accuracy |
| 132, 32 | Laboratory control samples > ± 3 sigma | LCS | Accuracy |
| 174, 74 | LCS data not submitted | LCS | Representativeness |
| 63 | Expected LCS value not submitted/verifiable | LCS | Representativeness |
| 62 | LCS relative percent error criteria not met | LCS | Accuracy |
| 105 | Low-level check sample recovery criteria were not met | LCS | Accuracy |
| 230 | QC sample/analyte (e.g., spike, duplicate, LCS) not analyzed | LCS | Representativeness |
| 28 | Duplicate analysis was not performed | Matrices | Precision |
| 11, 235 | Duplicate sample precision criteria were not met | Matrices | Precision |
| 111 | LCS/LCSD precision criteria were not met | Matrices | Precision |
| 128 | Laboratory duplicate was not analyzed | Matrices | Precision |
| 231 | MS/MSD criteria not met | Matrices | Precision |
| 116, 16 | MSA calibration correlation coefficient <0.995 | Matrices | Accuracy |
| 115, 15 | MSA was required but not performed | Matrices | Representativeness |
| 58 | Sample contained < 10 percent solid material | Matrices | Representativeness |
| 57 | Sample contained < 30 percent solid material | Matrices | Representativeness |
| 217 | Post-digestion spike recoveries were < 10% | Matrices | Accuracy |
| 14, 114, 216 | Post-digestion matrix spike criteria were not met | Matrices | Accuracy |
| 113, 13 | Predigestion matrix spike recovery is <30% | Matrices | Accuracy |

**Table A2.4**
**Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters**

| Validation Reason Codes | Standardized Description | QC Category | Affected PARCC Parameter |
|---|---|---|---|
| 112, 12 | Predigestion matrix spike recovery criteria were not met | Matrices | Accuracy |
| 27 | Recovery criteria were not met | Matrices | Accuracy |
| 31 | Replicate analysis was not performed | Matrices | Precision |
| 130, 30 | Replicate precision criteria were not met | Matrices | Precision |
| 61 | Replicate recovery criteria were not met | Matrices | Accuracy |
| 233 | Sample matrix QC does not represent samples analyzed | Matrices | Representativeness |
| 117, 17 | Serial dilution criteria not met | Matrices | Accuracy |
| 806 | Site samples not used for sample matrix QC | Matrices | Representativeness |
| 810 | EDD does not match hard copy; EDD may be resubmitted | Other | Other |
| 214 | IDL is older than 3 months from date of analysis | Other | Accuracy |
| 250 | Incorrect analysis sequence | Other | Representativeness |
| 808 | Incorrect or incomplete DRC | Other | Representativeness |
| 212 | Instrument detection limit was not provided | Other | Other |
| 87 | Laboratory did no analysis for this record | Other | Other |
| 809 | Nonsite samples reported with Site samples | Other | Other |
| 64 | Nontraceable/noncertified standard was used | Other | Accuracy |
| 51 | Nonverifiable laboratory results and/or unsubmitted data | Other | Representativeness |
| 211 | Poor cleanup recovery | Other | Accuracy |
| 25 | Primary standard had exceeded expiration date | Other | Accuracy |
| 234 | QC sample does not meet method requirement | Other | Representativeness |
| 168, 68 | QC sample frequency does not meet requirements | Other | Representativeness |
| 252 | Result is suspect due to dilution | Other | Other |
| 79 | Result obtained through dilution | Other | Other |
| 37 | Sample exceeded efficiency curve weight limit | Other | Accuracy |
| 247 | Sample or control analyses not chemically separated from each other | Other | Representativeness |
| 90 | Sample result was not validated due to re-analysis | Other | Other |
| 67 | Sample results not submitted/verifiable | Other | Representativeness |
| 199, 99 | See hard copy for further explanation | Other | Other |
| 248 | Single combined TCLP results was not reported for sample with both mis+nonm | Other | Accuracy |
| 80 | Spurious counts of unknown origin | Other | Representativeness |
| 244 | Standard or tracer is not NIST traceable | Other | Accuracy |
| 164 | Standard traceability or certification requirements not met | Other | Accuracy |
| 219 | Standards have expired or are not valid | Other | Accuracy |
| 243 | Standard values were not calculated correctly (LCS, tracer, standards) | Other | Other |
| 22 | Tracer contamination | Other | Accuracy |
| 242 | Tracer requirements were not met | Other | Accuracy |
| 71 | Unit conversion of results | Other | Other |

**Table A2.4**

**Standardized V&V Reason Code Definitions, QC Categories, and Affected PARCC Parameters**

| Validation Reason Codes | Standardized Description | QC Category | Affected PARCC Parameter |
|---|---|---|---|
| 239 | Winsorized mean+standard deviation of the same not calculated or calculated wrong | Other | Other |
| 38 | Excessive solids on planchet | Sample preparation | Accuracy |
| 123, 23 | Improper aliquot size | Sample preparation | Accuracy |
| 224 | Incomplete TCLP extraction data | Sample preparation | Representativeness |
| 225 | Insufficient TCLP extraction time | Sample preparation | Representativeness |
| 201 | Preservation requirements not met by the laboratory | Sample preparation | Representativeness |
| 24 | Sample aliquot not taken quantitatively | Sample preparation | Accuracy |
| 240 | Sample preparation for soil/sludge/ sediment were not homog/aliq properly | Sample preparation | Representativeness |
| 207 | Sample pretreatment or preparation method is incorrect | Sample preparation | Representativeness |
| 69 | Samples not distilled | Sample preparation | Representativeness |
| 703 | Samples were not preserved properly in the field | Sample preparation | Representativeness |
| 222 | TCLP particle size was not performed | Sample preparation | Representativeness |
| 220 | TCLP sample percent solids < 0.5 percent | Sample preparation | Representativeness |
| 56 | IDL changed due to significant figure discrepancy | Sensitivity | Representativeness |
| 54 | Incorrect reported activity or MDA | Sensitivity | Other |
| 213 | Instrument detection limit > the associated RDL | Sensitivity | Representativeness |
| 136, 36 | MDA exceeded the RDL | Sensitivity | Representativeness |
| 78 | MDA was calculated by reviewer | Sensitivity | Other |
| 81 | Repeat count outside of 3 sigma counting error | Sensitivity | Precision |
| 86 | Results considered qualitative not quantitative | Sensitivity | Accuracy |
| 82 | Sample results were not corrected for decay | Sensitivity | Other |
| 91 | Unit conversion, QC sample activity uncertainty/MDA | Sensitivity | Representativeness |
| 142, 42 | Surrogates were outside criteria | Surrogate | Accuracy |
| 20 | AA duplicate injection precision criteria were not met | Instrument Set-up | Precision |
| 73 | Daily instrument performance assessment not performed | Instrument Set-up | Accuracy |
| 177, 77 | Detector efficiency criteria not met | Instrument Set-up | Accuracy |
| 229 | Element not analyzed in ICP interference check sample | Instrument Set-up | Representativeness |
| 76 | Instrument gain and/or efficiency not submitted | Instrument Set-up | Representativeness |
| 109, 9 | Interference indicated in the ICP interference check sample | Instrument Set-up | Accuracy |
| 147, 47 | Percent breakdown exceeded 20 percent | Instrument Set-up | Representativeness |
| 170 | Resolution criteria not met | Instrument Set-up | Representativeness |
| 35 | Transformed spectral index external site criteria were not met | Instrument Set-up | Representativeness |
| 139, 39 | Tune criteria not met | Instrument Set-up | Accuracy |
| 206 | Analysis was not requested according to SOW | Unknown | Other |
| 166 | Carrier aliquot nonverifiable | Unknown | Representativeness |
| 150 | Unknown carrier volume | Unknown | Representativeness |

Table A2.5
Summary of V&V Observations

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| Dioxins and Furans | SOIL | Blanks | Method, preparation, or reagent blank contamination | Yes | 32 | 187 | 17.11 |
| Dioxins and Furans | SOIL | Internal Standards | Internal standards did not meet criteria | Yes | 2 | 187 | 1.07 |
| Herbicide | SOIL | Calibration | Continuing calibration verification criteria were not met | No | 2 | 173 | 1.16 |
| Herbicide | SOIL | Documentation Issues | Record added by the validator | No | 4 | 173 | 2.31 |
| Herbicide | SOIL | Documentation Issues | Transcription error | No | 4 | 173 | 2.31 |
| Herbicide | SOIL | Holding Times | Holding times were exceeded | No | 6 | 173 | 3.47 |
| Herbicide | SOIL | Internal Standards | Internal standards did not meet criteria | No | 2 | 173 | 1.16 |
| Herbicide | SOIL | Other | Sample results were not validated due to re-analysis | No | 1 | 173 | 0.58 |
| Herbicide | SOIL | Other | See hard copy for further explanation | No | 1 | 173 | 0.58 |
| Herbicide | SOIL | Surrogates | Surrogate recovery criteria were not met | No | 1 | 173 | 0.58 |
| Herbicide | WATER | Calibration | Continuing calibration verification criteria were not met | No | 3 | 181 | 1.66 |
| Herbicide | WATER | Documentation Issues | Transcription error | No | 1 | 181 | 0.55 |
| Herbicide | WATER | Holding Times | Holding times were exceeded | No | 3 | 181 | 1.66 |
| Herbicide | WATER | Other | Sample results were not validated due to re-analysis | No | 2 | 181 | 1.10 |
| Herbicide | WATER | Other | See hard copy for further explanation | No | 2 | 181 | 1.10 |
| Metal | SOIL | Blanks | Calibration verification blank contamination | No | 43 | 11,455 | 0.38 |
| Metal | SOIL | Blanks | Calibration verification blank contamination | Yes | 9 | 11,455 | 0.08 |
| Metal | SOIL | Blanks | Method, preparation, or reagent blank contamination | No | 571 | 11,455 | 4.98 |
| Metal | SOIL | Blanks | Method, preparation, or reagent blank contamination | Yes | 114 | 11,455 | 1.00 |
| Metal | SOIL | Blanks | Negative bias indicated in the blanks | No | 109 | 11,455 | 0.95 |
| Metal | SOIL | Blanks | Negative bias indicated in the blanks | Yes | 62 | 11,455 | 0.54 |
| Metal | SOIL | Calibration | Calibration correlation coefficient did not meet requirements | No | 17 | 11,455 | 0.15 |
| Metal | SOIL | Calibration | Calibration correlation coefficient did not meet requirements | Yes | 17 | 11,455 | 0.15 |
| Metal | SOIL | Calibration | Continuing calibration verification criteria were not met | No | 3 | 11,455 | 0.03 |
| Metal | SOIL | Calibration | Continuing calibration verification criteria were not met | Yes | 5 | 11,455 | 0.04 |
| Metal | SOIL | Documentation Issues | Key data fields incorrect | No | 13 | 11,455 | 0.11 |
| Metal | SOIL | Documentation Issues | Key data fields incorrect | Yes | 20 | 11,455 | 0.17 |
| Metal | SOIL | Documentation Issues | Record added by the validator | No | 57 | 11,455 | 0.50 |
| Metal | SOIL | Documentation Issues | Record added by the validator | Yes | 116 | 11,455 | 1.01 |
| Metal | SOIL | Documentation Issues | Transcription error | No | 94 | 11,455 | 0.82 |
| Metal | SOIL | Documentation Issues | Transcription error | Yes | 421 | 11,455 | 3.68 |
| Metal | SOIL | Holding Times | Holding times were exceeded | No | 12 | 11,455 | 0.10 |

**Table A2.5**
**Summary of V&V Observations**

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| Metal | SOIL | Holding Times | Holding times were exceeded | Yes | 71 | 11,455 | 0.62 |
| Metal | SOIL | Instrument Set-up | Interference was indicated in the interference check sample | No | 64 | 11,455 | 0.56 |
| Metal | SOIL | Instrument Set-up | Interference was indicated in the interference check sample | Yes | 124 | 11,455 | 1.08 |
| Metal | SOIL | LCS | CRDL check sample recovery criteria were not met | No | 117 | 11,455 | 1.02 |
| Metal | SOIL | LCS | CRDL check sample recovery criteria were not met | Yes | 162 | 11,455 | 1.41 |
| Metal | SOIL | LCS | LCS recovery criteria were not met | No | 386 | 11,455 | 3.37 |
| Metal | SOIL | LCS | LCS recovery criteria were not met | Yes | 787 | 11,455 | 6.87 |
| Metal | SOIL | LCS | Low level check sample recovery criteria were not met | No | 22 | 11,455 | 0.19 |
| Metal | SOIL | LCS | Low level check sample recovery criteria were not met | Yes | 22 | 11,455 | 0.19 |
| Metal | SOIL | Matrices | Duplicate sample precision criteria were not met | No | 12 | 11,455 | 0.10 |
| Metal | SOIL | Matrices | Duplicate sample precision criteria were not met | Yes | 474 | 11,455 | 4.14 |
| Metal | SOIL | Matrices | LCS/LCSD precision criteria were not met | Yes | 19 | 11,455 | 0.17 |
| Metal | SOIL | Matrices | MSA calibration correlation coefficient < 0.995 | Yes | 1 | 11,455 | 0.01 |
| Metal | SOIL | Matrices | Percent solids < 30 percent | No | 20 | 11,455 | 0.17 |
| Metal | SOIL | Matrices | Percent solids < 30 percent | Yes | 113 | 11,455 | 0.99 |
| Metal | SOIL | Matrices | Post-digestion MS did not meet control criteria | No | 73 | 11,455 | 0.64 |
| Metal | SOIL | Matrices | Post-digestion MS did not meet control criteria | Yes | 66 | 11,455 | 0.58 |
| Metal | SOIL | Matrices | Predigestion MS recovery criteria were not met | No | 338 | 11,455 | 2.95 |
| Metal | SOIL | Matrices | Predigestion MS recovery criteria were not met | Yes | 667 | 11,455 | 5.82 |
| Metal | SOIL | Matrices | Predigestion MS recovery was < 30 percent | Yes | 12 | 11,455 | 0.10 |
| Metal | SOIL | Matrices | Serial dilution criteria were not met | Yes | 415 | 11,455 | 3.62 |
| Metal | SOIL | Other | IDL is older than 3 months from date of analysis | No | 134 | 11,455 | 1.17 |
| Metal | SOIL | Other | IDL is older than 3 months from date of analysis | Yes | 461 | 11,455 | 4.02 |
| Metal | SOIL | Other | Result obtained through dilution | Yes | 6 | 11,455 | 0.05 |
| Metal | SOIL | Other | See hard copy for further explanation | No | 72 | 11,455 | 0.63 |
| Metal | SOIL | Other | See hard copy for further explanation | Yes | 344 | 11,455 | 3.00 |
| Metal | SOIL | Sensitivity | IDL changed due to a significant figure discrepancy | No | 11 | 11,455 | 0.10 |
| Metal | WATER | Blanks | Calibration verification blank contamination | No | 1,164 | 33,908 | 3.43 |
| Metal | WATER | Blanks | Calibration verification blank contamination | Yes | 188 | 33,908 | 0.55 |
| Metal | WATER | Blanks | Method, preparation, or reagent blank contamination | No | 1,842 | 33,908 | 5.43 |
| Metal | WATER | Blanks | Method, preparation, or reagent blank contamination | Yes | 483 | 33,908 | 1.42 |
| Metal | WATER | Blanks | Negative bias indicated in the blanks | No | 326 | 33,908 | 0.96 |

## Table A2.5
## Summary of V&V Observations

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| Metal | WATER | Blanks | Negative bias indicated in the blanks | Yes | 192 | 33,908 | 0.57 |
| Metal | WATER | Calculation Errors | Calculation error | No | 5 | 33,908 | 0.01 |
| Metal | WATER | Calculation Errors | Calculation error | Yes | 1 | 33,908 | 0.00 |
| Metal | WATER | Calculation Errors | Control limits not assigned correctly | No | 79 | 33,908 | 0.23 |
| Metal | WATER | Calculation Errors | Control limits not assigned correctly | Yes | 72 | 33,908 | 0.21 |
| Metal | WATER | Calibration | Calibration correlation coefficient did not meet requirements | No | 147 | 33,908 | 0.43 |
| Metal | WATER | Calibration | Calibration correlation coefficient did not meet requirements | Yes | 26 | 33,908 | 0.08 |
| Metal | WATER | Calibration | Continuing calibration verification criteria were not met | No | 16 | 33,908 | 0.05 |
| Metal | WATER | Calibration | Continuing calibration verification criteria were not met | Yes | 20 | 33,908 | 0.06 |
| Metal | WATER | Calibration | Frequency or sequencing verification criteria not met | No | 13 | 33,908 | 0.04 |
| Metal | WATER | Calibration | Frequency or sequencing verification criteria not met | Yes | 50 | 33,908 | 0.15 |
| Metal | WATER | Documentation Issues | Electronic qualifiers were applied from validation report by hand | No | 20 | 33,908 | 0.06 |
| Metal | WATER | Documentation Issues | Electronic qualifiers were applied from validation report by hand | Yes | 9 | 33,908 | 0.03 |
| Metal | WATER | Documentation Issues | Information missing from case narrative | No | 10 | 33,908 | 0.03 |
| Metal | WATER | Documentation Issues | Information missing from case narrative | Yes | 13 | 33,908 | 0.04 |
| Metal | WATER | Documentation Issues | Key data fields incorrect | No | 103 | 33,908 | 0.30 |
| Metal | WATER | Documentation Issues | Key data fields incorrect | Yes | 308 | 33,908 | 0.91 |
| Metal | WATER | Documentation Issues | Missing deliverables (not required for validation) | No | 217 | 33,908 | 0.64 |
| Metal | WATER | Documentation Issues | Missing deliverables (not required for validation) | Yes | 225 | 33,908 | 0.66 |
| Metal | WATER | Documentation Issues | Missing deliverables (required for validation) | No | 169 | 33,908 | 0.50 |
| Metal | WATER | Documentation Issues | Missing deliverables (required for validation) | Yes | 198 | 33,908 | 0.58 |
| Metal | WATER | Documentation Issues | Omissions or errors in data package (not required for validation) | No | 675 | 33,908 | 1.99 |
| Metal | WATER | Documentation Issues | Omissions or errors in data package (not required for validation) | Yes | 1,113 | 33,908 | 3.28 |
| Metal | WATER | Documentation Issues | Omissions or errors in data package (required for validation) | No | 8 | 33,908 | 0.02 |
| Metal | WATER | Documentation Issues | Omissions or errors in data package (required for validation) | Yes | 1 | 33,908 | 0.00 |
| Metal | WATER | Documentation Issues | Record added by the validator | No | 21 | 33,908 | 0.06 |
| Metal | WATER | Documentation Issues | Record added by the validator | Yes | 23 | 33,908 | 0.07 |
| Metal | WATER | Documentation Issues | Reported data does not agree with raw data | No | 1 | 33,908 | 0.00 |
| Metal | WATER | Documentation Issues | Transcription error | No | 837 | 33,908 | 2.47 |
| Metal | WATER | Documentation Issues | Transcription error | Yes | 384 | 33,908 | 1.13 |
| Metal | WATER | Holding Times | Holding times were exceeded | No | 80 | 33,908 | 0.24 |
| Metal | WATER | Holding Times | Holding times were exceeded | Yes | 47 | 33,908 | 0.14 |

**Table A2.5**
**Summary of V&V Observations**

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| Metal | WATER | Holding Times | Holding times were grossly exceeded | Yes | 4 | 33,908 | 0.01 |
| Metal | WATER | Instrument Set-up | AA duplicate injection precision criteria were not met | No | 4 | 33,908 | 0.01 |
| Metal | WATER | Instrument Set-up | AA duplicate injection precision criteria were not met | Yes | 1 | 33,908 | 0.00 |
| Metal | WATER | Instrument Set-up | Interference was indicated in the interference check sample | No | 54 | 33,908 | 0.16 |
| Metal | WATER | Instrument Set-up | Interference was indicated in the interference check sample | Yes | 161 | 33,908 | 0.47 |
| Metal | WATER | LCS | CRDL check sample recovery criteria were not met | No | 252 | 33,908 | 0.74 |
| Metal | WATER | LCS | CRDL check sample recovery criteria were not met | Yes | 174 | 33,908 | 0.51 |
| Metal | WATER | LCS | LCS data not submitted by the laboratory | No | 1 | 33,908 | 0.00 |
| Metal | WATER | LCS | LCS recovery criteria were not met | No | 89 | 33,908 | 0.26 |
| Metal | WATER | LCS | LCS recovery criteria were not met | Yes | 107 | 33,908 | 0.32 |
| Metal | WATER | LCS | Low level check sample recovery criteria were not met | No | 271 | 33,908 | 0.80 |
| Metal | WATER | LCS | Low level check sample recovery criteria were not met | Yes | 282 | 33,908 | 0.83 |
| Metal | WATER | LCS | QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed | No | 79 | 33,908 | 0.23 |
| Metal | WATER | LCS | QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed | Yes | 83 | 33,908 | 0.24 |
| Metal | WATER | Matrices | Duplicate sample precision criteria were not met | No | 40 | 33,908 | 0.12 |
| Metal | WATER | Matrices | Duplicate sample precision criteria were not met | Yes | 129 | 33,908 | 0.38 |
| Metal | WATER | Matrices | LCS/LCSD precision criteria were not met | No | 43 | 33,908 | 0.13 |
| Metal | WATER | Matrices | LCS/LCSD precision criteria were not met | Yes | 40 | 33,908 | 0.12 |
| Metal | WATER | Matrices | MSA calibration correlation coefficient < 0.995 | No | 1 | 33,908 | 0.00 |
| Metal | WATER | Matrices | MSA calibration correlation coefficient < 0.995 | Yes | 6 | 33,908 | 0.02 |
| Metal | WATER | Matrices | Post-digestion MS did not meet control criteria | No | 305 | 33,908 | 0.90 |
| Metal | WATER | Matrices | Post-digestion MS did not meet control criteria | Yes | 44 | 33,908 | 0.13 |
| Metal | WATER | Matrices | Predigestion MS recovery criteria were not met | No | 416 | 33,908 | 1.23 |
| Metal | WATER | Matrices | Predigestion MS recovery criteria were not met | Yes | 396 | 33,908 | 1.17 |
| Metal | WATER | Matrices | Predigestion MS recovery was < 30 percent | No | 2 | 33,908 | 0.01 |
| Metal | WATER | Matrices | Predigestion MS recovery was < 30 percent | Yes | 15 | 33,908 | 0.04 |
| Metal | WATER | Matrices | Recovery criteria were not met | Yes | 1 | 33,908 | 0.00 |
| Metal | WATER | Matrices | Serial dilution criteria were not met | No | 29 | 33,908 | 0.09 |
| Metal | WATER | Matrices | Serial dilution criteria were not met | Yes | 687 | 33,908 | 2.03 |
| Metal | WATER | Matrices | Site samples were not used for sample matrix QC | No | 5 | 33,908 | 0.01 |
| Metal | WATER | Matrices | Site samples were not used for sample matrix QC | Yes | 22 | 33,908 | 0.06 |
| Metal | WATER | Other | IDL is older than 3 months from date of analysis | No | 602 | 33,908 | 1.78 |

**Table A2.5**
**Summary of V&V Observations**

| Analyte Group | Matrix | QC Category | V&V Observation | Detect? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| Metal | WATER | Other | IDL is older than 3 months from date of analysis | Yes | 951 | 33,908 | 2.80 |
| Metal | WATER | Other | Result obtained through dilution | Yes | 1 | 33,908 | 0.00 |
| Metal | WATER | Other | See hard copy for further explanation | No | 19 | 33,908 | 0.06 |
| Metal | WATER | Other | See hard copy for further explanation | Yes | 25 | 33,908 | 0.07 |
| Metal | WATER | Sample Preparation | Samples were not properly preserved in the field | No | 312 | 33,908 | 0.92 |
| Metal | WATER | Sample Preparation | Samples were not properly preserved in the field | Yes | 559 | 33,908 | 1.65 |
| Metal | WATER | Sensitivity | IDL changed due to a significant figure discrepancy | No | 73 | 33,908 | 0.22 |
| Metal | WATER | Sensitivity | Instrument detection limit > the associated RDL | Yes | 1 | 33,908 | 0.00 |
| PCB | SOIL | Documentation Issues | Transcription error | No | 35 | 1,467 | 2.39 |
| PCB | SOIL | Holding Times | Holding times were exceeded | No | 49 | 1,467 | 3.34 |
| PCB | SOIL | Other | See hard copy for further explanation | Yes | 1 | 1,467 | 0.07 |
| PCB | SOIL | Surrogates | Surrogate recovery criteria were not met | Yes | 1 | 1,467 | 0.07 |
| PCB | WATER | Documentation Issues | Transcription error | No | 75 | 1,050 | 7.14 |
| PCB | WATER | Holding Times | Holding times were exceeded | No | 35 | 1,050 | 3.33 |
| PCB | WATER | Surrogates | Surrogate recovery criteria were not met | No | 42 | 1,050 | 4.00 |
| Pesticide | SOIL | Calibration | Continuing calibration verification criteria were not met | No | 14 | 4,340 | 0.32 |
| Pesticide | SOIL | Calibration | Continuing calibration verification criteria were not met | Yes | 3 | 4,340 | 0.07 |
| Pesticide | SOIL | Documentation Issues | Record added by the validator | No | 6 | 4,340 | 0.14 |
| Pesticide | SOIL | Documentation Issues | Transcription error | No | 21 | 4,340 | 0.48 |
| Pesticide | SOIL | Holding Times | Holding times were exceeded | No | 146 | 4,340 | 3.36 |
| Pesticide | SOIL | Internal Standards | Internal standards did not meet criteria | No | 2 | 4,340 | 0.05 |
| Pesticide | SOIL | Other | Sample results were not validated due to re-analysis | No | 1 | 4,340 | 0.02 |
| Pesticide | SOIL | Other | See hard copy for further explanation | No | 7 | 4,340 | 0.16 |
| Pesticide | SOIL | Surrogates | Surrogate recovery criteria were not met | No | 3 | 4,340 | 0.07 |
| Pesticide | WATER | Blanks | Method, preparation, or reagent blank contamination | No | 4 | 3,168 | 0.13 |
| Pesticide | WATER | Calibration | Continuing calibration verification criteria were not met | No | 38 | 3,168 | 1.20 |
| Pesticide | WATER | Documentation Issues | Transcription error | No | 154 | 3,168 | 4.86 |
| Pesticide | WATER | Holding Times | Holding times were exceeded | No | 108 | 3,168 | 3.41 |
| Pesticide | WATER | Other | Sample results were not validated due to re-analysis | No | 2 | 3,168 | 0.06 |
| Pesticide | WATER | Other | See hard copy for further explanation | No | 2 | 3,168 | 0.06 |
| Pesticide | WATER | Other | See hard copy for further explanation | Yes | 4 | 3,168 | 0.13 |
| Pesticide | WATER | Surrogates | Surrogate recovery criteria were not met | No | 106 | 3,168 | 3.35 |

Table A2.5
Summary of V&V Observations

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| Radionuclide | SOIL | Blanks | Blank recovery criteria were not met | Yes | 68 | 2,842 | 2.39 |
| Radionuclide | SOIL | Blanks | Method, preparation, or reagent blank contamination | No | 7 | 2,842 | 0.25 |
| Radionuclide | SOIL | Blanks | Method, preparation, or reagent blank contamination | Yes | 416 | 2,842 | 14.64 |
| Radionuclide | SOIL | Calculation Errors | Calculation error | Yes | 5 | 2,842 | 0.18 |
| Radionuclide | SOIL | Calibration | Continuing calibration verification criteria were not met | Yes | 147 | 2,842 | 5.17 |
| Radionuclide | SOIL | Documentation Issues | Key data fields incorrect | Yes | 28 | 2,842 | 0.99 |
| Radionuclide | SOIL | Documentation Issues | Record added by the validator | Yes | 50 | 2,842 | 1.76 |
| Radionuclide | SOIL | Documentation Issues | Results were not included on Data Summary Table | Yes | 1 | 2,842 | 0.04 |
| Radionuclide | SOIL | Documentation Issues | Sample analysis was not requested | Yes | 3 | 2,842 | 0.11 |
| Radionuclide | SOIL | Documentation Issues | Sufficient documentation not provided by the laboratory | Yes | 387 | 2,842 | 13.62 |
| Radionuclide | SOIL | Documentation Issues | Transcription error | No | 18 | 2,842 | 0.63 |
| Radionuclide | SOIL | Documentation Issues | Transcription error | Yes | 307 | 2,842 | 10.80 |
| Radionuclide | SOIL | Holding Times | Holding times were grossly exceeded | Yes | 3 | 2,842 | 0.11 |
| Radionuclide | SOIL | Instrument Set-up | Detector efficiency did not meet requirements | Yes | 16 | 2,842 | 0.56 |
| Radionuclide | SOIL | Instrument Set-up | Resolution criteria were not met | Yes | 12 | 2,842 | 0.42 |
| Radionuclide | SOIL | LCS | Lab control samples >+/- 2 sigma and <+/- 3 sigma | Yes | 4 | 2,842 | 0.14 |
| Radionuclide | SOIL | LCS | LCS data not submitted by the laboratory | Yes | 29 | 2,842 | 1.02 |
| Radionuclide | SOIL | LCS | LCS recovery > +/- 3 sigma | No | 8 | 2,842 | 0.28 |
| Radionuclide | SOIL | LCS | LCS recovery > +/- 3 sigma | Yes | 306 | 2,842 | 10.77 |
| Radionuclide | SOIL | LCS | LCS recovery criteria were not met | No | 5 | 2,842 | 0.18 |
| Radionuclide | SOIL | LCS | LCS recovery criteria were not met | Yes | 32 | 2,842 | 1.13 |
| Radionuclide | SOIL | LCS | LCS relative percent error criteria not met | No | 17 | 2,842 | 0.60 |
| Radionuclide | SOIL | LCS | LCS relative percent error criteria not met | Yes | 198 | 2,842 | 6.97 |
| Radionuclide | SOIL | Matrices | Recovery criteria were not met | Yes | 41 | 2,842 | 1.44 |
| Radionuclide | SOIL | Matrices | Replicate analysis was not performed | Yes | 4 | 2,842 | 0.14 |
| Radionuclide | SOIL | Matrices | Replicate precision criteria were not met | No | 2 | 2,842 | 0.07 |
| Radionuclide | SOIL | Matrices | Replicate precision criteria were not met | Yes | 304 | 2,842 | 10.70 |
| Radionuclide | SOIL | Matrices | Replicate recovery criteria were not met | No | 4 | 2,842 | 0.14 |
| Radionuclide | SOIL | Matrices | Replicate recovery criteria were not met | Yes | 57 | 2,842 | 2.01 |
| Radionuclide | SOIL | Other | Lab results not verified due to unsubmitted data | Yes | 69 | 2,842 | 2.43 |
| Radionuclide | SOIL | Other | QC sample does not meet method requirements | No | 16 | 2,842 | 0.56 |
| Radionuclide | SOIL | Other | QC sample does not meet method requirements | Yes | 9 | 2,842 | 0.32 |

## Table A2.5
## Summary of V&V Observations

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| Radionuclide | SOIL | Other | Sample exceeded efficiency curve weight limit | Yes | 5 | 2,842 | 0.18 |
| Radionuclide | SOIL | Other | See hard copy for further explanation | No | 3 | 2,842 | 0.11 |
| Radionuclide | SOIL | Other | See hard copy for further explanation | Yes | 87 | 2,842 | 3.06 |
| Radionuclide | SOIL | Sensitivity | Incorrect reported activity or MDA | No | 2 | 2,842 | 0.07 |
| Radionuclide | SOIL | Sensitivity | Incorrect reported activity or MDA | Yes | 2 | 2,842 | 0.07 |
| Radionuclide | SOIL | Sensitivity | MDA exceeded the RDL | No | 2 | 2,842 | 0.07 |
| Radionuclide | SOIL | Sensitivity | MDA exceeded the RDL | Yes | 43 | 2,842 | 1.51 |
| Radionuclide | SOIL | Sensitivity | MDA was calculated by reviewer | Yes | 639 | 2,842 | 22.48 |
| Radionuclide | WATER | Blanks | Blank data not submitted | Yes | 4 | 6,339 | 0.06 |
| Radionuclide | WATER | Blanks | Blank recovery criteria were not met | No | 6 | 6,339 | 0.09 |
| Radionuclide | WATER | Blanks | Blank recovery criteria were not met | Yes | 51 | 6,339 | 0.80 |
| Radionuclide | WATER | Blanks | Method, preparation, or reagent blank contamination | No | 44 | 6,339 | 0.69 |
| Radionuclide | WATER | Blanks | Method, preparation, or reagent blank contamination | Yes | 393 | 6,339 | 6.20 |
| Radionuclide | WATER | Calculation Errors | Calculation error | No | 6 | 6,339 | 0.09 |
| Radionuclide | WATER | Calculation Errors | Calculation error | Yes | 13 | 6,339 | 0.21 |
| Radionuclide | WATER | Calibration | Calibration counting statistics did not meet criteria | No | 25 | 6,339 | 0.39 |
| Radionuclide | WATER | Calibration | Calibration counting statistics did not meet criteria | Yes | 3 | 6,339 | 0.05 |
| Radionuclide | WATER | Calibration | Continuing calibration verification criteria were not met | No | 113 | 6,339 | 1.78 |
| Radionuclide | WATER | Calibration | Continuing calibration verification criteria were not met | Yes | 466 | 6,339 | 7.35 |
| Radionuclide | WATER | Documentation Issues | Information missing from case narrative | No | 1 | 6,339 | 0.02 |
| Radionuclide | WATER | Documentation Issues | Information missing from case narrative | Yes | 10 | 6,339 | 0.16 |
| Radionuclide | WATER | Documentation Issues | Key data fields incorrect | Yes | 1 | 6,339 | 0.02 |
| Radionuclide | WATER | Documentation Issues | Missing deliverables (required for validation) | No | 1 | 6,339 | 0.02 |
| Radionuclide | WATER | Documentation Issues | Missing deliverables (required for validation) | Yes | 4 | 6,339 | 0.06 |
| Radionuclide | WATER | Documentation Issues | Omissions or errors in data package (not required for validation) | No | 15 | 6,339 | 0.24 |
| Radionuclide | WATER | Documentation Issues | Omissions or errors in data package (not required for validation) | Yes | 62 | 6,339 | 0.98 |
| Radionuclide | WATER | Documentation Issues | Omissions or errors in data package (required for validation) | No | 4 | 6,339 | 0.06 |
| Radionuclide | WATER | Documentation Issues | Omissions or errors in data package (required for validation) | Yes | 20 | 6,339 | 0.32 |
| Radionuclide | WATER | Documentation Issues | Record added by the validator | Yes | 76 | 6,339 | 1.20 |
| Radionuclide | WATER | Documentation Issues | Sample analysis was not requested | Yes | 8 | 6,339 | 0.13 |
| Radionuclide | WATER | Documentation Issues | Sufficient documentation not provided by the laboratory | No | 2 | 6,339 | 0.03 |
| Radionuclide | WATER | Documentation Issues | Sufficient documentation not provided by the laboratory | Yes | 557 | 6,339 | 8.79 |

Table A2.5
Summary of V&V Observations

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| Radionuclide | WATER | Documentation Issues | Transcription error | No | 294 | 6,339 | 4.64 |
| Radionuclide | WATER | Documentation Issues | Transcription error | Yes | 263 | 6,339 | 4.15 |
| Radionuclide | WATER | Holding Times | Holding times were exceeded | No | 59 | 6,339 | 0.93 |
| Radionuclide | WATER | Holding Times | Holding times were exceeded | Yes | 93 | 6,339 | 1.47 |
| Radionuclide | WATER | Holding Times | Holding times were grossly exceeded | No | 4 | 6,339 | 0.06 |
| Radionuclide | WATER | Holding Times | Holding times were grossly exceeded | Yes | 13 | 6,339 | 0.21 |
| Radionuclide | WATER | Instrument Set-up | Resolution criteria were not met | No | 6 | 6,339 | 0.09 |
| Radionuclide | WATER | Instrument Set-up | Resolution criteria were not met | Yes | 21 | 6,339 | 0.33 |
| Radionuclide | WATER | Instrument Set-up | Transformed spectral index external site criteria were not met | No | 5 | 6,339 | 0.08 |
| Radionuclide | WATER | LCS | Expected LCS value not submitted/verifiable | No | 21 | 6,339 | 0.33 |
| Radionuclide | WATER | LCS | Expected LCS value not submitted/verifiable | Yes | 66 | 6,339 | 1.04 |
| Radionuclide | WATER | LCS | LCS recovery > +/- 3 sigma | No | 125 | 6,339 | 1.97 |
| Radionuclide | WATER | LCS | LCS recovery > +/- 3 sigma | Yes | 157 | 6,339 | 2.48 |
| Radionuclide | WATER | LCS | LCS recovery criteria were not met | No | 14 | 6,339 | 0.22 |
| Radionuclide | WATER | LCS | LCS recovery criteria were not met | Yes | 31 | 6,339 | 0.49 |
| Radionuclide | WATER | LCS | LCS relative percent error criteria not met | No | 47 | 6,339 | 0.74 |
| Radionuclide | WATER | LCS | LCS relative percent error criteria not met | Yes | 225 | 6,339 | 3.55 |
| Radionuclide | WATER | Matrices | Duplicate sample precision criteria were not met | No | 1 | 6,339 | 0.02 |
| Radionuclide | WATER | Matrices | Duplicate sample precision criteria were not met | Yes | 1 | 6,339 | 0.02 |
| Radionuclide | WATER | Matrices | Laboratory duplicate was not analyzed | No | 1 | 6,339 | 0.02 |
| Radionuclide | WATER | Matrices | Laboratory duplicate was not analyzed | Yes | 1 | 6,339 | 0.02 |
| Radionuclide | WATER | Matrices | Recovery criteria were not met | No | 13 | 6,339 | 0.21 |
| Radionuclide | WATER | Matrices | Recovery criteria were not met | Yes | 31 | 6,339 | 0.49 |
| Radionuclide | WATER | Matrices | Replicate analysis was not performed | No | 23 | 6,339 | 0.36 |
| Radionuclide | WATER | Matrices | Replicate analysis was not performed | Yes | 73 | 6,339 | 1.15 |
| Radionuclide | WATER | Matrices | Replicate precision criteria were not met | No | 59 | 6,339 | 0.93 |
| Radionuclide | WATER | Matrices | Replicate precision criteria were not met | Yes | 245 | 6,339 | 3.86 |
| Radionuclide | WATER | Matrices | Replicate recovery criteria were not met | No | 2 | 6,339 | 0.03 |
| Radionuclide | WATER | Matrices | Replicate recovery criteria were not met | Yes | 6 | 6,339 | 0.09 |
| Radionuclide | WATER | Other | Lab results not verified due to unsubmitted data | No | 1 | 6,339 | 0.02 |
| Radionuclide | WATER | Other | Lab results not verified due to unsubmitted data | Yes | 16 | 6,339 | 0.25 |
| Radionuclide | WATER | Other | QC sample does not meet method requirements | No | 13 | 6,339 | 0.21 |

**Table A2.5**
**Summary of V&V Observations**

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| Radionuclide | WATER | Other | QC sample does not meet method requirements | Yes | 25 | 6,339 | 0.39 |
| Radionuclide | WATER | Other | Sample exceeded efficiency curve weight limit | Yes | 4 | 6,339 | 0.06 |
| Radionuclide | WATER | Other | See hard copy for further explanation | No | 90 | 6,339 | 1.42 |
| Radionuclide | WATER | Other | See hard copy for further explanation | Yes | 283 | 6,339 | 4.46 |
| Radionuclide | WATER | Other | Tracer requirements were not met | No | 14 | 6,339 | 0.22 |
| Radionuclide | WATER | Other | Tracer requirements were not met | Yes | 89 | 6,339 | 1.40 |
| Radionuclide | WATER | Other | Unit conversion of results | Yes | 2 | 6,339 | 0.03 |
| Radionuclide | WATER | Sample Preparation | Improper aliquot size | Yes | 1 | 6,339 | 0.02 |
| Radionuclide | WATER | Sample Preparation | Samples were not properly preserved in the field | Yes | 6 | 6,339 | 0.09 |
| Radionuclide | WATER | Sensitivity | Incorrect reported activity or MDA | No | 3 | 6,339 | 0.05 |
| Radionuclide | WATER | Sensitivity | Incorrect reported activity or MDA | Yes | 18 | 6,339 | 0.28 |
| Radionuclide | WATER | Sensitivity | MDA exceeded the RDL | No | 17 | 6,339 | 0.27 |
| Radionuclide | WATER | Sensitivity | MDA exceeded the RDL | Yes | 153 | 6,339 | 2.41 |
| Radionuclide | WATER | Sensitivity | MDA was calculated by reviewer | No | 14 | 6,339 | 0.22 |
| Radionuclide | WATER | Sensitivity | MDA was calculated by reviewer | Yes | 1,120 | 6,339 | 17.67 |
| SVOC | SOIL | Blanks | Method, preparation, or reagent blank contamination | No | 54 | 12,363 | 0.44 |
| SVOC | SOIL | Blanks | Method, preparation, or reagent blank contamination | Yes | 3 | 12,363 | 0.02 |
| SVOC | SOIL | Calculation Errors | Calculation error | Yes | 3 | 12,363 | 0.02 |
| SVOC | SOIL | Calibration | Continuing calibration verification criteria were not met | No | 21 | 12,363 | 0.17 |
| SVOC | SOIL | Calibration | Continuing calibration verification criteria were not met | Yes | 49 | 12,363 | 0.40 |
| SVOC | SOIL | Calibration | Original result exceeded linear range, serial dilution value reported | Yes | 2 | 12,363 | 0.02 |
| SVOC | SOIL | Documentation Issues | Record added by the validator | No | 231 | 12,363 | 1.87 |
| SVOC | SOIL | Documentation Issues | Record added by the validator | Yes | 1 | 12,363 | 0.01 |
| SVOC | SOIL | Documentation Issues | Transcription error | No | 222 | 12,363 | 1.80 |
| SVOC | SOIL | Documentation Issues | Transcription error | Yes | 69 | 12,363 | 0.56 |
| SVOC | SOIL | Holding Times | Holding times were exceeded | No | 345 | 12,363 | 2.79 |
| SVOC | SOIL | Holding Times | Holding times were exceeded | Yes | 7 | 12,363 | 0.06 |
| SVOC | SOIL | Internal Standards | Internal standards did not meet criteria | No | 110 | 12,363 | 0.89 |
| SVOC | SOIL | Internal Standards | Internal standards did not meet criteria | Yes | 17 | 12,363 | 0.14 |
| SVOC | SOIL | Matrices | Percent solids < 30 percent | Yes | 9 | 12,363 | 0.07 |
| SVOC | SOIL | Other | Sample results were not validated due to re-analysis | No | 39 | 12,363 | 0.32 |
| SVOC | SOIL | Other | Sample results were not validated due to re-analysis | Yes | 40 | 12,363 | 0.32 |

**Table A2.5**
**Summary of V&V Observations**

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| SVOC | SOIL | Other | See hard copy for further explanation | No | 58 | 12,363 | 0.47 |
| SVOC | SOIL | Other | See hard copy for further explanation | Yes | 18 | 12,363 | 0.15 |
| SVOC | SOIL | Surrogates | Surrogate recovery criteria were not met | No | 123 | 12,363 | 0.99 |
| SVOC | SOIL | Surrogates | Surrogate recovery criteria were not met | Yes | 16 | 12,363 | 0.13 |
| SVOC | WATER | Blanks | Method, preparation, or reagent blank contamination | No | 65 | 12,210 | 0.53 |
| SVOC | WATER | Blanks | Method, preparation, or reagent blank contamination | Yes | 4 | 12,210 | 0.03 |
| SVOC | WATER | Calibration | Continuing calibration verification criteria were not met | No | 160 | 12,210 | 1.31 |
| SVOC | WATER | Calibration | Continuing calibration verification criteria were not met | Yes | 3 | 12,210 | 0.02 |
| SVOC | WATER | Calibration | Independent calibration verification criteria not met | No | 14 | 12,210 | 0.11 |
| SVOC | WATER | Documentation Issues | Information missing from case narrative | No | 12 | 12,210 | 0.10 |
| SVOC | WATER | Documentation Issues | Missing deliverables (not required for validation) | No | 48 | 12,210 | 0.39 |
| SVOC | WATER | Documentation Issues | Omissions or errors in data package (not required for validation) | No | 212 | 12,210 | 1.74 |
| SVOC | WATER | Documentation Issues | Omissions or errors in data package (not required for validation) | Yes | 1 | 12,210 | 0.01 |
| SVOC | WATER | Documentation Issues | Omissions or errors in data package (required for validation) | No | 6 | 12,210 | 0.05 |
| SVOC | WATER | Documentation Issues | Original documentation not provided | No | 3 | 12,210 | 0.02 |
| SVOC | WATER | Documentation Issues | Transcription error | No | 45 | 12,210 | 0.37 |
| SVOC | WATER | Documentation Issues | Transcription error | Yes | 2 | 12,210 | 0.02 |
| SVOC | WATER | Holding Times | Holding times were exceeded | No | 385 | 12,210 | 3.15 |
| SVOC | WATER | Holding Times | Holding times were exceeded | Yes | 6 | 12,210 | 0.05 |
| SVOC | WATER | Instrument Set-up | Instrument tune criteria were not met | No | 125 | 12,210 | 1.02 |
| SVOC | WATER | Instrument Set-up | Instrument tune criteria were not met | Yes | 1 | 12,210 | 0.01 |
| SVOC | WATER | LCS | LCS recovery criteria were not met | No | 55 | 12,210 | 0.45 |
| SVOC | WATER | LCS | LCS recovery criteria were not met | Yes | 2 | 12,210 | 0.02 |
| SVOC | WATER | Matrices | MS/MSD precision criteria were not met | No | 3 | 12,210 | 0.02 |
| SVOC | WATER | Matrices | MS/MSD precision criteria were not met | Yes | 1 | 12,210 | 0.01 |
| SVOC | WATER | Other | Sample results were not validated due to re-analysis | No | 105 | 12,210 | 0.86 |
| SVOC | WATER | Other | Sample results were not validated due to re-analysis | Yes | 7 | 12,210 | 0.06 |
| SVOC | WATER | Other | See hard copy for further explanation | No | 110 | 12,210 | 0.90 |
| SVOC | WATER | Other | See hard copy for further explanation | Yes | 2 | 12,210 | 0.02 |
| SVOC | WATER | Sample Preparation | Preservation requirements were not met by the laboratory | No | 3 | 12,210 | 0.02 |
| SVOC | WATER | Sample Preparation | Samples were not properly preserved in the field | No | 71 | 12,210 | 0.58 |
| SVOC | WATER | Sample Preparation | Samples were not properly preserved in the field | Yes | 1 | 12,210 | 0.01 |

**Table A2.5**
**Summary of V&V Observations**

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| SVOC | WATER | Surrogates | Surrogate recovery criteria were not met | No | 48 | 12,210 | 0.39 |
| SVOC | WATER | Surrogates | Surrogate recovery criteria were not met | Yes | 2 | 12,210 | 0.02 |
| VOC | SOIL | Blanks | Method, preparation, or reagent blank contamination | No | 226 | 8,550 | 2.64 |
| VOC | SOIL | Blanks | Method, preparation, or reagent blank contamination | Yes | 20 | 8,550 | 0.23 |
| VOC | SOIL | Calculation Errors | Calculation error | No | 34 | 8,550 | 0.40 |
| VOC | SOIL | Calibration | Continuing calibration verification criteria were not met | No | 45 | 8,550 | 0.53 |
| VOC | SOIL | Calibration | Continuing calibration verification criteria were not met | Yes | 22 | 8,550 | 0.26 |
| VOC | SOIL | Calibration | Original result exceeded linear range, serial dilution value reported | Yes | 1 | 8,550 | 0.01 |
| VOC | SOIL | Confirmation | Results were not confirmed | No | 1 | 8,550 | 0.01 |
| VOC | SOIL | Documentation Issues | Record added by the validator | No | 178 | 8,550 | 2.08 |
| VOC | SOIL | Documentation Issues | Record added by the validator | Yes | 8 | 8,550 | 0.09 |
| VOC | SOIL | Documentation Issues | Transcription error | No | 271 | 8,550 | 3.17 |
| VOC | SOIL | Documentation Issues | Transcription error | Yes | 12 | 8,550 | 0.14 |
| VOC | SOIL | Holding Times | Holding times were exceeded | No | 118 | 8,550 | 1.38 |
| VOC | SOIL | Holding Times | Holding times were exceeded | Yes | 4 | 8,550 | 0.05 |
| VOC | SOIL | Internal Standards | Internal standards did not meet criteria | No | 84 | 8,550 | 0.98 |
| VOC | SOIL | Internal Standards | Internal standards did not meet criteria | Yes | 4 | 8,550 | 0.05 |
| VOC | SOIL | Matrices | Percent solids < 30 percent | Yes | 8 | 8,550 | 0.09 |
| VOC | SOIL | Other | Lab results not verified due to unsubmitted data | No | 1 | 8,550 | 0.01 |
| VOC | SOIL | Other | Sample results were not validated due to re-analysis | No | 280 | 8,550 | 3.27 |
| VOC | SOIL | Other | Sample results were not validated due to re-analysis | Yes | 26 | 8,550 | 0.30 |
| VOC | SOIL | Other | See hard copy for further explanation | No | 4 | 8,550 | 0.05 |
| VOC | SOIL | Other | See hard copy for further explanation | Yes | 2 | 8,550 | 0.02 |
| VOC | SOIL | Surrogates | Surrogate recovery criteria were not met | No | 104 | 8,550 | 1.22 |
| VOC | SOIL | Surrogates | Surrogate recovery criteria were not met | Yes | 7 | 8,550 | 0.08 |
| VOC | WATER | Blanks | Method, preparation, or reagent blank contamination | No | 174 | 45,430 | 0.38 |
| VOC | WATER | Blanks | Method, preparation, or reagent blank contamination | Yes | 77 | 45,430 | 0.17 |
| VOC | WATER | Calibration | Continuing calibration verification criteria were not met | No | 908 | 45,430 | 2.00 |
| VOC | WATER | Calibration | Continuing calibration verification criteria were not met | Yes | 42 | 45,430 | 0.09 |
| VOC | WATER | Calibration | Independent calibration verification criteria not met | No | 59 | 45,430 | 0.13 |
| VOC | WATER | Calibration | Independent calibration verification criteria not met | Yes | 23 | 45,430 | 0.05 |
| VOC | WATER | Calibration | Original result exceeded linear range, serial dilution value reported | Yes | 3 | 45,430 | 0.01 |

## Table A2.5
## Summary of V&V Observations

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| VOC | WATER | Calibration | Result exceeded linear range of measurement system | Yes | 1 | 45,430 | 0.00 |
| VOC | WATER | Confirmation | Results were not confirmed | No | 7 | 45,430 | 0.02 |
| VOC | WATER | Documentation Issues | Information missing from case narrative | No | 223 | 45,430 | 0.49 |
| VOC | WATER | Documentation Issues | Missing deliverables (not required for validation) | No | 865 | 45,430 | 1.90 |
| VOC | WATER | Documentation Issues | Missing deliverables (not required for validation) | Yes | 15 | 45,430 | 0.03 |
| VOC | WATER | Documentation Issues | Omissions or errors in data package (not required for validation) | No | 3,729 | 45,430 | 8.21 |
| VOC | WATER | Documentation Issues | Omissions or errors in data package (not required for validation) | Yes | 101 | 45,430 | 0.22 |
| VOC | WATER | Documentation Issues | Omissions or errors in data package (required for validation) | No | 109 | 45,430 | 0.24 |
| VOC | WATER | Documentation Issues | Omissions or errors in data package (required for validation) | Yes | 1 | 45,430 | 0.00 |
| VOC | WATER | Documentation Issues | Original documentation not provided | No | 54 | 45,430 | 0.12 |
| VOC | WATER | Documentation Issues | Record added by the validator | No | 79 | 45,430 | 0.17 |
| VOC | WATER | Documentation Issues | Transcription error | No | 1,211 | 45,430 | 2.67 |
| VOC | WATER | Documentation Issues | Transcription error | Yes | 51 | 45,430 | 0.11 |
| VOC | WATER | Holding Times | Holding times were exceeded | No | 2,815 | 45,430 | 6.20 |
| VOC | WATER | Holding Times | Holding times were exceeded | Yes | 14 | 45,430 | 0.03 |
| VOC | WATER | Holding Times | Holding times were grossly exceeded | Yes | 1 | 45,430 | 0.00 |
| VOC | WATER | Instrument Set-up | Instrument tune criteria were not met | No | 2,232 | 45,430 | 4.91 |
| VOC | WATER | Instrument Set-up | Instrument tune criteria were not met | Yes | 65 | 45,430 | 0.14 |
| VOC | WATER | Internal Standards | Internal standards did not meet criteria | No | 97 | 45,430 | 0.21 |
| VOC | WATER | Internal Standards | Internal standards did not meet criteria | Yes | 2 | 45,430 | 0.00 |
| VOC | WATER | LCS | LCS recovery criteria were not met | No | 646 | 45,430 | 1.42 |
| VOC | WATER | LCS | LCS recovery criteria were not met | Yes | 42 | 45,430 | 0.09 |
| VOC | WATER | Matrices | MS/MSD precision criteria were not met | No | 91 | 45,430 | 0.20 |
| VOC | WATER | Matrices | MS/MSD precision criteria were not met | Yes | 11 | 45,430 | 0.02 |
| VOC | WATER | Other | Sample results were not validated due to re-analysis | No | 8 | 45,430 | 0.02 |
| VOC | WATER | Other | Sample results were not validated due to re-analysis | Yes | 2 | 45,430 | 0.00 |
| VOC | WATER | Other | See hard copy for further explanation | No | 71 | 45,430 | 0.16 |
| VOC | WATER | Other | See hard copy for further explanation | Yes | 13 | 45,430 | 0.03 |
| VOC | WATER | Sample Preparation | Preservation requirements were not met by the laboratory | No | 49 | 45,430 | 0.11 |
| VOC | WATER | Sample Preparation | Samples were not properly preserved in the field | No | 1,273 | 45,430 | 2.80 |
| VOC | WATER | Sample Preparation | Samples were not properly preserved in the field | Yes | 45 | 45,430 | 0.10 |
| VOC | WATER | Sensitivity | Instrument detection limit > the associated RDL | No | 8 | 45,430 | 0.02 |

Table A2.5
Summary of V&V Observations

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| VOC | WATER | Surrogates | Surrogate recovery criteria were not met | No | 172 | 45,430 | 0.38 |
| VOC | WATER | Surrogates | Surrogate recovery criteria were not met | Yes | 3 | 45,430 | 0.01 |
| Wet Chemistry | SOIL | Blanks | Method, preparation, or reagent blank contamination | No | 1 | 94 | 1.06 |
| Wet Chemistry | SOIL | Documentation Issues | Record added by the validator | No | 1 | 94 | 1.06 |
| Wet Chemistry | SOIL | Documentation Issues | Record added by the validator | Yes | 1 | 94 | 1.06 |
| Wet Chemistry | SOIL | Holding Times | Holding times were exceeded | No | 2 | 94 | 2.13 |
| Wet Chemistry | SOIL | Holding Times | Holding times were exceeded | Yes | 1 | 94 | 1.06 |
| Wet Chemistry | SOIL | Holding Times | Holding times were grossly exceeded | No | 1 | 94 | 1.06 |
| Wet Chemistry | SOIL | Matrices | Duplicate sample precision criteria were not met | Yes | 2 | 94 | 2.13 |
| Wet Chemistry | SOIL | Matrices | Percent solids < 30 percent | Yes | 5 | 94 | 5.32 |
| Wet Chemistry | SOIL | Matrices | Predigestion MS recovery criteria were not met | No | 4 | 94 | 4.26 |
| Wet Chemistry | SOIL | Matrices | Predigestion MS recovery criteria were not met | Yes | 12 | 94 | 12.77 |
| Wet Chemistry | SOIL | Matrices | Predigestion MS recovery was < 30 percent | Yes | 24 | 94 | 25.53 |
| Wet Chemistry | SOIL | Other | IDL is older than 3 months from date of analysis | Yes | 21 | 94 | 22.34 |
| Wet Chemistry | WATER | Blanks | Method, preparation, or reagent blank contamination | No | 23 | 3,592 | 0.64 |
| Wet Chemistry | WATER | Blanks | Negative bias indicated in the blanks | No | 13 | 3,592 | 0.36 |
| Wet Chemistry | WATER | Blanks | Negative bias indicated in the blanks | Yes | 1 | 3,592 | 0.03 |
| Wet Chemistry | WATER | Calculation Errors | Control limits not assigned correctly | Yes | 1 | 3,592 | 0.03 |
| Wet Chemistry | WATER | Calibration | Calibration correlation coefficient did not meet requirements | No | 1 | 3,592 | 0.03 |
| Wet Chemistry | WATER | Calibration | Calibration correlation coefficient did not meet requirements | Yes | 6 | 3,592 | 0.17 |
| Wet Chemistry | WATER | Calibration | Continuing calibration verification criteria were not met | Yes | 14 | 3,592 | 0.39 |
| Wet Chemistry | WATER | Calibration | Result exceeded linear range of measurement system | Yes | 4 | 3,592 | 0.11 |
| Wet Chemistry | WATER | Documentation Issues | Missing deliverables (not required for validation) | Yes | 4 | 3,592 | 0.11 |
| Wet Chemistry | WATER | Documentation Issues | Missing deliverables (required for validation) | Yes | 1 | 3,592 | 0.03 |
| Wet Chemistry | WATER | Documentation Issues | Omissions or errors in data package (not required for validation) | No | 3 | 3,592 | 0.08 |
| Wet Chemistry | WATER | Documentation Issues | Omissions or errors in data package (not required for validation) | Yes | 43 | 3,592 | 1.20 |
| Wet Chemistry | WATER | Documentation Issues | Omissions or errors in data package (required for validation) | Yes | 1 | 3,592 | 0.03 |
| Wet Chemistry | WATER | Documentation Issues | Record added by the validator | No | 39 | 3,592 | 1.09 |
| Wet Chemistry | WATER | Documentation Issues | Record added by the validator | Yes | 35 | 3,592 | 0.97 |
| Wet Chemistry | WATER | Documentation Issues | Transcription error | No | 54 | 3,592 | 1.50 |
| Wet Chemistry | WATER | Documentation Issues | Transcription error | Yes | 160 | 3,592 | 4.45 |
| Wet Chemistry | WATER | Holding Times | Holding times were exceeded | No | 15 | 3,592 | 0.42 |

**Table A2.5**
**Summary of V&V Observations**

| Analyte Group | Matrix | QC Category | V&V Observation | Detect ? | No. of Qualified Results | Total No. of V&V Records | Percent Qualified (%) |
|---|---|---|---|---|---|---|---|
| Wet Chemistry | WATER | Holding Times | Holding times were exceeded | Yes | 39 | 3,592 | 1.09 |
| Wet Chemistry | WATER | Holding Times | Holding times were grossly exceeded | No | 24 | 3,592 | 0.67 |
| Wet Chemistry | WATER | Holding Times | Holding times were grossly exceeded | Yes | 19 | 3,592 | 0.53 |
| Wet Chemistry | WATER | LCS | LCS recovery criteria were not met | No | 3 | 3,592 | 0.08 |
| Wet Chemistry | WATER | Matrices | Duplicate sample precision criteria were not met | Yes | 2 | 3,592 | 0.06 |
| Wet Chemistry | WATER | Matrices | LCS/LCSD precision criteria were not met | Yes | 1 | 3,592 | 0.03 |
| Wet Chemistry | WATER | Matrices | Predigestion MS recovery criteria were not met | No | 31 | 3,592 | 0.86 |
| Wet Chemistry | WATER | Matrices | Predigestion MS recovery criteria were not met | Yes | 85 | 3,592 | 2.37 |
| Wet Chemistry | WATER | Matrices | Predigestion MS recovery was < 30 percent | Yes | 4 | 3,592 | 0.11 |
| Wet Chemistry | WATER | Matrices | Site samples were not used for sample matrix QC | Yes | 3 | 3,592 | 0.08 |
| Wet Chemistry | WATER | Other | Lab results not verified due to unsubmitted data | No | 1 | 3,592 | 0.03 |
| Wet Chemistry | WATER | Other | Lab results not verified due to unsubmitted data | Yes | 37 | 3,592 | 1.03 |
| Wet Chemistry | WATER | Other | Result obtained through dilution | Yes | 11 | 3,592 | 0.31 |
| Wet Chemistry | WATER | Other | See hard copy for further explanation | No | 1 | 3,592 | 0.03 |
| Wet Chemistry | WATER | Other | See hard copy for further explanation | Yes | 7 | 3,592 | 0.19 |
| Wet Chemistry | WATER | Sample Preparation | Preservation requirements were not met by the laboratory | Yes | 13 | 3,592 | 0.36 |
| Wet Chemistry | WATER | Sample Preparation | Sample pretreatment or preparation method was incorrect | Yes | 1 | 3,592 | 0.03 |
| Wet Chemistry | WATER | Sample Preparation | Samples were not properly preserved in the field | No | 1 | 3,592 | 0.03 |
| Wet Chemistry | WATER | Sample Preparation | Samples were not properly preserved in the field | Yes | 13 | 3,592 | 0.36 |

**Table A2.6**
**Summary of Data Rejected During V&V**

| Analyte Group | Matrix | Total No. of Rejected Records | Total No. of Records | Percent Rejected (%) |
|---|---|---|---|---|
| Dioxins and Furans | SOIL | 0 | 205 | 0.00 |
| Dioxins and Furans | WATER | 0 | 14 | 0.00 |
| Herbicide | SOIL | 20 | 299 | 6.69 |
| Herbicide | WATER | 12 | 250 | 4.80 |
| Metal | SOIL | 425 | 18,555 | 2.29 |
| Metal | WATER | 1,715 | 52,456 | 3.27 |
| PCB | SOIL | 48 | 2,238 | 2.14 |
| PCB | WATER | 14 | 1,505 | 0.93 |
| Pesticide | SOIL | 167 | 6,689 | 2.50 |
| Pesticide | WATER | 48 | 4,538 | 1.06 |
| Radionuclide | SOIL | 438 | 5,833 | 7.51 |
| Radionuclide | WATER | 1,270 | 10,841 | 11.71 |
| SVOC | SOIL | 762 | 19,356 | 3.94 |
| SVOC | WATER | 264 | 15,914 | 1.66 |
| VOC | SOIL | 704 | 18,574 | 3.79 |
| VOC | WATER | 1,802 | 60,052 | 3.00 |
| Wet Chemistry | SOIL | 11 | 349 | 3.15 |
| Wet Chemistry | WATER | 111 | 5,761 | 1.93 |
| | **Total** | **7,811** | **223,429** | **3.50%** |

**Table A2.7**
**Summary of RPDs/DERs of Field Duplicate Analyte Pairs**

| Analyte Group | Matrix | No. of Duplicates Failing RPD/DER Criteria | Total No. of Duplicate Pairs | Percent Failure (%) | Field Duplicate Frequency (%) |
|---|---|---|---|---|---|
| Dioxins and Furans | SOIL | 7 | 34 | 20.59 | 18.18 |
| Herbicide | SOIL | 0 | 26 | 0.00 | 14.94 |
| Metal | SOIL | 72 | 1,245 | 5.78 | 10.82 |
| Metal | WATER | 93 | 2,584 | 3.60 | 6.63 |
| PCB | SOIL | 1 | 202 | 0.50 | 13.51 |
| Pesticide | SOIL | 0 | 610 | 0.00 | 13.76 |
| Radionuclide | SOIL | 12 | 368 | 3.26 | 11.66 |
| Radionuclide | WATER | 3 | 564 | 0.53 | 6.81 |
| SVOC | SOIL | 3 | 1,771 | 0.17 | 14.20 |
| SVOC | WATER | 1 | 913 | 0.11 | 5.84 |
| VOC | SOIL | 0 | 403 | 0.00 | 4.46 |
| VOC | WATER | 3 | 2,244 | 0.13 | 4.31 |
| Wet Chemistry | SOIL | 0 | 22 | 0.00 | 20.75 |
| Wet Chemistry | WATER | 7 | 279 | 2.51 | 6.59 |

**Table A2.8**
**Summary of Data Estimated or Undetected Due to V&V Determinations**

| Analyte Group | Matrix | No. of CRA Data Records Qualified | Total No. of V&V CRA Records | Detect? | Percent Qualified (%) |
|---|---|---|---|---|---|
| Dioxins and Furans | SOIL | 34 | 187 | Yes | 18.18 |
| Herbicide | SOIL | 12 | 173 | No | 6.94 |
| Herbicide | WATER | 8 | 181 | No | 4.42 |
| Metal | SOIL | 1,654 | 11,455 | No | 14.44 |
| Metal | SOIL | 2,641 | 11,455 | Yes | 23.06 |
| Metal | WATER | 4,610 | 33,908 | No | 13.60 |
| Metal | WATER | 2,735 | 33,908 | Yes | 8.07 |
| PCB | SOIL | 49 | 1,467 | No | 3.34 |
| PCB | WATER | 77 | 1,050 | No | 7.33 |
| Pesticide | SOIL | 165 | 4,340 | No | 3.80 |
| Pesticide | SOIL | 3 | 4,340 | Yes | 0.07 |
| Pesticide | WATER | 245 | 3,168 | No | 7.73 |
| Radionuclide | SOIL | 1 | 2,842 | No | 0.04 |
| Radionuclide | SOIL | 16 | 2,842 | Yes | 0.56 |
| Radionuclide | WATER | 33 | 6,339 | No | 0.52 |
| Radionuclide | WATER | 76 | 6,339 | Yes | 1.20 |
| SVOC | SOIL | 707 | 12,363 | No | 5.72 |
| SVOC | SOIL | 27 | 12,363 | Yes | 0.22 |
| SVOC | WATER | 757 | 12,210 | No | 6.20 |
| SVOC | WATER | 7 | 12,210 | Yes | 0.06 |
| VOC | SOIL | 535 | 8,550 | No | 6.26 |
| VOC | SOIL | 40 | 8,550 | Yes | 0.47 |
| VOC | WATER | 4,484 | 45,430 | No | 9.87 |
| VOC | WATER | 140 | 45,430 | Yes | 0.31 |
| Wet Chemistry | SOIL | 8 | 94 | No | 8.51 |
| Wet Chemistry | SOIL | 44 | 94 | Yes | 46.81 |
| Wet Chemistry | WATER | 105 | 3,592 | No | 2.92 |
| Wet Chemistry | WATER | 202 | 3,592 | Yes | 5.62 |
| | **Total** | **19,415** | **147,363** | | **13.17%** |

**Table A2.9**
**Summary of Data Qualified as Undetected Due to Blank Contamination**

| Analyte Group | Matrix | No. of CRA Records Qualified as Undetected | Total No. of CRA Records with Detected Results[a] | Percent Qualified as Undetected |
|---|---|---|---|---|
| Metal | SOIL | 26 | 8,329 | 0.31 |
| Metal | WATER | 725 | 16,841 | 4.30 |
| VOC | SOIL | 1 | 219 | 0.46 |
| VOC | WATER | 12 | 873 | 1.37 |
| Wet Chemistry | WATER | 2 | 2,611 | 0.08 |
| | **Total** | **766** | **28,873** | **2.65%** |

[a] As determined by the laboratory prior to V&V.

# COMPREHENSIVE RISK ASSESSMENT

## UPPER WOMAN DRAINAGE EXPOSURE UNIT

## VOLUME 10: ATTACHMENT 3

## Statistical Analyses and Professional Judgment

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| μg/kg | Micrograms per kilogram |
| AL | action level |
| CDH | Colorado Department of Health |
| CDPHE | Colorado Department of Public Health and Environment |
| CMS | Corrective Measures Study |
| COC | contaminant of concern |
| CRA | Comprehensive Risk Assessment |
| DOE | U.S. Department of Energy |
| DQA | Data Quality Assessment |
| ECOI | ecological contaminant of interest |
| EcoSSL | Ecological Soil Screening Level |
| ECOPC | ecological contaminant of potential concern |
| EPA | U.S. Environmental Protection Agency |
| EPC | exposure point concentration |
| ERA | Ecological Risk Assessment |
| ESL | ecological screening level |
| EU | Exposure Unit |
| GIS | Geographical Information System |
| HEPA | High-Efficiency Particulate Air |
| HHRA | Human Health Risk Assessment |
| HRR | Historical Release Report |
| IHSS | Individual Hazardous Substance Site |
| MDC | maximum detected concentration |
| mg/kg | milligrams per kilogram |

| | |
|---|---|
| NCP | National Contingency Plan |
| NFA | No Further Action |
| NOAEL | no observed adverse effect level |
| OU | Operable Unit |
| PAC | Potential Area of Concern |
| PCB | polychlorinated biphenyl |
| pCi/g | picocuries per gram |
| PCOC | potential contaminant of concern |
| PDSR | Pre-Demolition Survey Report |
| PMJM | Preble's meadow jumping mouse |
| PRG | preliminary remediation goal |
| UWOEU | Upper Woman Drainage Exposure Unit |
| RFCA | Rocky Flats Cleanup Agreement |
| RFETS | Rocky Flats Environmental Technology Site |
| RI/FS | Remedial Investigation/Feasibility Study |
| RLCR | Reconnaissance-Level Characterization Reports |
| tESL | threshold ESL |
| UBC | Under Building Contamination |
| UCL | upper confidence limit |
| UTL | upper tolerance limit |
| WRS | Wilcoxon Rank Sum |
| WRW | wildlife refuge worker |

# 1.0 INTRODUCTION

This attachment presents the results for the statistical analyses and professional judgment evaluation used to select human health contaminants of concern (COCs) as part of the Human Health Risk Assessment (HHRA) and ecological contaminants of potential concern (ECOPCs) as part of the Ecological Risk Assessment (ERA) for the Upper Woman Drainage Exposure Unit (EU) (UWOEU) at the Rocky Flats Environmental Technology Site (RFETS). The methods used to perform the statistical analysis and to develop the professional judgment sections are described in Appendix A, Volume 2, Section 2.0 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation/Corrective Measures Study (CMS)-Feasibility Study (RI/FS) Report (hereafter referred to as the RI/FS Report).

# 2.0 RESULTS OF STATISTICAL COMPARISONS TO BACKGROUND FOR THE UPPER WOMAN DRAINAGE EXPOSURE UNIT

The results of the statistical background comparisons for inorganic and radionuclide potential contaminants of concern (PCOCs) and ecological contaminants of interest (ECOIs) in surface soil/surface sediment, subsurface soil/subsurface sediment, surface soil, and subsurface soil samples collected from the UWOEU are presented in this section. Box plots are provided for analytes that were carried forward into the statistical comparison step and are presented in Figures A3.2.1 to A3.2.40.[1] The box plots display several reference points: 1) the line inside the box is the median; 2) the lower edge of the box is the 25th percentile; 3) the upper edge of the box is the 75th percentile; 4) the upper lines (called whiskers) are drawn to the greatest value that is less than or equal to 1.5 times the inter-quartile range (the interquartile range is between the 75th and 25th percentiles); 5) the lower whiskers are drawn to the lowest value that is greater than or equal to 1.5 times the inter-quartile range; and 6) solid circles are data points greater or less than the whiskers.

ECOIs for surface soil (Preble's meadow jumping mouse [PMJM] receptor) and PCOCs with concentrations in the UWOEU that are statistically greater than background (or those where background comparisons were not performed) are carried through to the professional judgment step of the COC/ECOPC selection processes. ECOIs (for non-PMJM receptors) with concentrations in the UWOEU that are statistically greater than

[1] Statistical background comparisons are not performed for analytes if: (1) the background concentrations are non-detections; 2) background data are unavailable; 3) the analyte has low detection frequency in the UWOEU or background data set (less than 20 percent); or 4) the analyte is an organic compound. Box plots are not provided for these analytes. However, these analytes are carried forward into the professional judgment evaluation.

background (or those where background comparisons were not performed) are carried through to the exposure point concentration (EPC) – minimum ecological screening level (ESL) comparison step of the ECOPC selection processes.

PCOCs and ECOIs with concentrations that are not statistically greater than background are not identified as COCs/ECOPCs and are not evaluated further.

## 2.1 Surface Soil/Surface Sediment Data Used in the HHRA

For the UWOEU surface soil/surface sediment data set, the maximum detected concentrations (MDCs) and upper confidence limits on the mean (UCLs) for arsenic, benzo(a)pyrene, dibenz(a,h)anthracene, 2,3,7,8-TCDD (TEQ), cesium-134, cesium-137, and radium-228 exceed the wildlife refuge worker (WRW) preliminary remediation goals (PRGs) for the UWOEU data set, and these PCOCs were carried forward into the statistical background comparison step. The results of the statistical comparison of the UWOEU surface soil/surface sediment data to background data for these PCOCs are presented in Table A3.2.1 and the summary statistics for background and UWOEU surface soil/surface sediment data are shown in Table A3.2.2. The UWOEU MDCs for all other PCOCs do not exceed the PRGs or the UCL for the UWOEU data set does not exceed the PRGs, and were not evaluated further.

The results of the statistical comparisons of the UWOEU surface soil/surface sediment data to background data indicate the following:

***Statistically Greater than Background at the 0.1 Significance Level***

- Arsenic

***Not Statistically Greater than Background at the 0.1 Significance Level***

- Cesium-134
- Cesium-137
- Radium-228

***Background Comparison Not Performed[1]***

- Benzo(a)pyrene
- Dibenz(a,h)anthracene (Eliminated based on low frequency of detection [less than 5 percent])
- 2,3,7,8-TCDD (TEQ)

## 2.2 Subsurface Soil/Subsurface Sediment Data Used in the HHRA

For the UWOEU subsurface soil/subsurface sediment data set, the MDCs and UCLs for radium-228 exceed the wildlife refuge worker (WRW) PRGs for the UWOEU data set, and this PCOC was carried forward into the statistical background comparison step. The results of the statistical comparison of the UWOEU subsurface soil/subsurface sediment data to background data for this PCOC is presented in Table A3.2.3 and the summary statistics for background and UWOEU subsurface soil/subsurface sediment data are shown in Table A3.2.4. The UWOEU MDCs for all other PCOCs do not exceed the PRGs or the UCL for the UWOEU data set does not exceed the PRGs, and were not evaluated further.

The results of the statistical comparisons of the UWOEU subsurface soil/subsurface sediment data to background data indicate the following:

*Statistically Greater than Background at the 0.1 Significance Level*

- None

*Not Statistically Greater than Background at the 0.1 Significance Level*

- Radium-228

*Background Comparison Not Performed*[1]

- None.

## 2.3 Surface Soil Data Used in the ERA (Non-PMJM Receptors)

For the ECOIs in surface soil, the MDCs for aluminum, antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, tin, uranium, vanadium, and zinc exceed a non-PMJM ESL, and these ECOIs were carried forward into the statistical background comparison step. The MDCs for 2-methylnaphthalene, 4,4'-DDT, acenaphthene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, dieldrin, 2,3,7,8-TCDD (TEQ) (mammal), 2,3,7,8-TCDD (TEQ) (bird), endrin ketone, fluorene, naphthalene, and total PCBs also exceed a non-PMJM ESL. The results of the statistical comparison of the UWOEU surface soil data to background data are presented in Table A3.2.5 and the summary statistics for background and UWOEU surface soil data are shown in Table A3.2.6.

The results of the statistical comparisons of the UWOEU surface soil to background data indicate the following:

*Statistically Greater than Background at the 0.1 Significance Level*

- Barium
- Copper

- Nickel
- Vanadium

***Not Statistically Greater than Background at the 0.1 Significance Level***

- Aluminum
- Arsenic
- Cadmium
- Chromium
- Cobalt
- Lead
- Lithium
- Manganese
- Mercury
- Selenium
- Zinc

***Background Comparison not Performed***[/]

- Antimony
- Boron
- Molybdenum
- Silver
- Tin
- Uranium
- 2-Methylnaphthalene
- 4,4'-DDT
- Acenaphthene
- Benzo(a)pyrene

- Bis(2 ethylhexyl)phthalate
- Di-n-butylphthalate
- Dieldrin
- 2,3,7,8-TCDD (TEQ) (mammal)
- 2,3,7,8-TCDD (TEQ) (bird)
- Endrin ketone
- Fluorene
- Naphthalene
- Total PCBs

## 2.4 Surface Soil Data used in the ERA (PMJM Receptors)

For the ECOIs in surface soil in PMJM habitat, the MDCs for antimony, arsenic, cadmium, chromium, copper, manganese, mercury, molybdenum, nickel, selenium, tin, vanadium, and zinc exceed the PMJM ESLs, and were carried forward into the background comparison step. The MDC for total PCBs also exceed a non-PMJM ESL. The results of the statistical comparison of the UWOEU surface soil data to background data are presented in Table A3.2.7 and the summary statistics for background and UWOEU surface soil data are shown in Table A3.2.8.

The results of the statistical comparisons of the UWOEU surface soil in PMJM habitat to background data indicate the following:

***Statistically Greater than Background at the 0.1 Significance Level***

- Chromium
- Copper
- Manganese
- Nickel
- Vanadium
- Zinc

***Not Statistically Greater than Background at the 0.1 Significance Level***

- Arsenic
- Cadmium

- Mercury
- Selenium

***Background Comparison not Performed[1]***

- Antimony
- Molybdenum
- Tin
- Total PCBs

## 2.5 Subsurface Soil Data used in the ERA

For the ECOIs in subsurface soil, the MDCs for antimony, arsenic, beryllium, chromium, copper, lead, manganese, molybdenum, nickel, selenium, tin, and zinc exceed the prairie dog ESL and were carried forward into the statistical background comparison step. The MDCs for all other ECOIs do not exceed the prairie dog ESL. The results of the statistical comparison of the UWOEU subsurface soil data to background data are presented in Table A3.9 and the summary statistics for background and UWOEU subsurface soil data are shown in Table A3.10.

The results of the statistical comparisons of the surface soil data to background data indicate the following:

***Statistically Greater than Background at the 0.1 Significance Level***

- Copper
- Manganese
- Zinc

***Not Statistically Greater than Background at the 0.1 Significance Level***

- Arsenic
- Beryllium
- Chromium
- Lead
- Molybdenum
- Nickel

***Background Comparison not Performed[1]***

- Antimony
- Selenium
- Tin

## 3.0 UPPER-BOUND EXPOSURE POINT CONCENTRATION COMPARISON TO LIMITING ECOLOGICAL SCREENING LEVELS

ECOIs in surface soil and subsurface soil with concentrations that are statistically greater than background, or background comparisons were not performed, are evaluated further by comparing the UWOEU EPCs to the limiting threshold (tESLs). The EPCs are the 95 percent UCLs of the 90th percentile [upper tolerance limit (UTL)] for small home-range receptors, the UCL for large home-range receptors, or the MDC in the event that the UCL or UTL is greater than the MDC.

### 3.1 ECOIs in Surface Soil

Barium, 2-methylnaphthalene, acenaphthene, benzo(a)pyrene, fluorene, and naphthalene in surface soil (non-PMJM) were eliminated from further consideration because the EPCs are not greater than the limiting tESLs (see Table 7.7). Antimony, boron, copper, molybdenum, nickel, silver, tin, uranium, and vanadium along with five organics (bis(2-ethylhexyl)phthalate, di-n-butylphthalate, 2,3,7,8-TCDD (TEQ) (mammal), 2,3,7,8-TCDD (TEQ) (bird), and total PCBs) have EPCs greater than the limiting tESLs and are evaluated in the professional judgment evaluation screening step (Section 4.0).

### 3.2 ECOIs in Subsurface Soil

Antimony, copper, manganese, selenium, tin, and zinc in subsurface soil were eliminated from further consideration because the EPCs are not greater than the tESLs (see Table 7.15). No ECOIs have an EPC greater than the limiting tESL and, therefore, no analytes are evaluated in the professional judgment evaluation screening step (Section 4.0).

## 4.0 PROFESSIONAL JUDGMENT

This section presents the results of the professional judgment step of the COC and ECOPC selection processes for the HHRA and ERA, respectively. Based on the weight of evidence evaluated in the professional judgment step, PCOCs and ECOIs are either included for further evaluation as COCs/ECOPCs in the risk characterization step, or excluded from further evaluation.

The professional judgment evaluation takes into account the following lines of evidence: process knowledge, spatial trends, pattern recognition[2], comparison to RFETS background and regional background data sets (see Table A3.11 for a summary of regional background data)[3], and risk potential. For PCOCs or ECOIs where the process knowledge and/or spatial trends indicate that the presence of the analyte in the EU may be a result of historical site-related activities, the professional judgment discussion includes only two of the lines of evidence listed above, and it is concluded that these analytes are COCs/ECOPCs and are carried forward into risk characterization. For the other PCOCs and ECOIs that are evaluated in the professional judgment step, each of the lines of evidence listed above are included in the discussion.

For metals, Appendix A, Volume 2, Attachment 8 of the RI/FS Report provides the details of the process knowledge and spatial trend evaluations. The conclusions from these evaluations are noted in this attachment.

The following PCOCs/ECOIs are evaluated further in the professional judgment step for UWOEU:

- Surface soil/surface sediment (HHRA)
  - Arsenic
  - Benzo(a)pyrene
  - 2,3,7,8-TCDD (TEQ)

---

[2] The pattern recognition evaluation includes the use of probability plots. If two or more distinct populations are evident in the probability plot, this suggests that one or more local releases may have occurred. Conversely, if only one distinct low-concentration population is defined, likely representing a background population, a local release may or may not have occurred. Similar to all statistical methods, the probability plot has limitations in cases where there is inadequate sampling and the magnitude of the release is relatively small. Thus, absence of two clear populations in the probability plots is consistent with, but not definitive proof of, the hypothesis that no releases have occurred. However, if a release has occurred within the sampled area and has been included in the samples, then the elemental concentrations associated with that release are either within the background concentration range or the entire sampled population represents a release, a highly unlikely probability.

[3] The regional background data set for Colorado and the bordering states was extracted from data for the western United States (Shacklette and Boerngen 1984), and is composed of data from Colorado as well as Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming. Although the Colorado and bordering states background data set is not specific to Colorado's Front Range, it is useful for the professional judgment evaluation in the absence of a robust data set for the Front Range. Colorado's Front Range has highly variable terrain that changes elevation over short distances. Consequently, numerous soil types and geologic materials are present at RFETS, and the data set for Colorado and bordering states may be more representative of these variable soil types.

- Subsurface soil/subsurface sediment (HHRA)
  - No PCOCs were found to be statistically greater than background and above a PRG in accordance with the COC selection process; therefore, no PCOCs in subsurface soil/subsurface sediment are evaluated using professional judgment.
- Surface soil for non-PMJM receptors (ERA)
  - Antimony
  - Boron
  - Copper
  - Molybdenum
  - Nickel
  - Silver
  - Tin
  - Uranium
  - Vanadium
  - Bis(2-Ethylhexyl)phthalate
  - Di-n-butylphthalate
  - 2,3,7,8-TCDD (TEQ) (mammal)
  - 2,3,7,8-TCDD (TEQ) (bird)
  - Total PCBs
- Surface soil for PMJM receptors (ERA)
  - Antimony
  - Chromium
  - Copper
  - Manganese
  - Molybdenum
  - Nickel
  - Tin
  - Vanadium
  - Zinc
  - Total PCBs
- Subsurface soil (ERA)
  - No ECOIs were found to be statistically greater than background and above an ESL in accordance with the ECOPC selection process; therefore, no ECOIs in subsurface soil are evaluated using professional judgment.

The following sections provide the professional judgment evaluations, by analyte and by medium, for the PCOCs/ECOIs listed above.

## 4.1 Antimony

Antimony had an EPC in surface soil for non-PMJM receptors greater than the limiting tESL and a MDC in surface soil for the PMJM greater than ESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if antimony should be retained for risk characterization are summarized below.

### 4.1.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates antimony was used in very small quantities and only as a laboratory standard. Therefore, antimony is unlikely to be present in UWOEU soil as a result of historical site-related activities.

### 4.1.2 Evaluation of Spatial Trends

*Surface Soil (Non-PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis for antimony could not be performed because antimony is at nondetectable concentrations in UWOEU background data set. Antimony concentrations exceed three times the background MDC in UWOEU and largely occur in historical IHSSs. Thus, antimony cannot be eliminated as an ECOPC.

*Surface Soil (PMJM)*

Antimony concentrations exceed three times the regional background MDC in UWOEU and largely occur in historical IHSSs. Thus, antimony cannot be eliminated as an ECOPC.

### 4.1.3 Conclusion

Antimony in surface soil is being carried forward into the ecological non-PMJM and PMJM risk characterization because elevated concentrations (greater than three times the regional background MDC) are located near an historic IHSS. Antimony was used in very small quantities during historical RFETS operations, which would indicate it is unlikely to be a site-related contaminant. Nevertheless, as a conservative measure, antimony is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

## 4.2 Arsenic

Arsenic has concentrations statistically greater than background in surface soil/surface sediment, and therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if arsenic should be retained for risk characterization are summarized below.

### 4.2.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates arsenic is unlikely to be present in UWOEU soil as a result of historical site-related activities.

### 4.2.2 Evaluation of Spatial Trends

*Surface Soil/Surface Sediment*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis suggests that arsenic concentrations in UWOEU surface soil/surface sediment reflect variations in naturally occurring arsenic.

### 4.2.3 Pattern Recognition

*Surface Soil/Surface Sediment*

With the exception of two surface sediment analyses, arsenic concentrations in surface soil/surface sediment form a normally distributed, single population suggesting background conditions (Figure A3.4.1). The two surface sediment samples have concentrations of 27.9 and 19.7 mg/kg respectively.

### 4.2.4 Comparison to RFETS Background and Other Background Data Sets

*Surface Soil/Surface Sediment*

Arsenic concentrations in UWOEU surface soil/surface sediment range from 0.290 to 27.9 mg/kg with a mean concentration of 5.07 mg/kg and a standard deviation of 3.05 mg/kg. Arsenic concentrations in the background data set range from 0.270 to 9.60 mg/kg with a mean concentration of 3.42 mg/kg and a standard deviation of 2.55 mg/kg (Table A3.2.2). The range of concentrations of arsenic in the UWOEU and background samples overlap considerably with only five of the 159 detections greater than the background MDC.

Arsenic concentrations UWOEU surface soil/surface sediment are well within the range for arsenic in soils of Colorado and the bordering states (1.22 to 97 mg/kg, with a mean concentration of 6.9 mg/kg and a standard deviation of 7.64 mg/kg) (Table A3.4.1).

### 4.2.5 Risk Potential for HHRA

*Surface Soil/Surface Sediment*

The arsenic MDC for surface soil/surface sediment is 27.9 mg/kg and the UCL is 6.11 mg/kg. The UCL is less than three times greater than the PRG (2.41 mg/kg), with 137 of the 159 detections greater than the PRG. Because the PRG is based on an excess carcinogenic risk of 1E-06, the cancer risk based on the UCL concentration is less than

3E-06, and is well within the National Contingency Plan (NCP) risk range of 1E-06 to 1E-04. Arsenic is detected in 67 of 73 background samples, and concentrations in 39 of the 67 samples with detects exceed the PRG. The background UCL for arsenic in surface soil/surface sediment is 4.03 mg/kg (Appendix A, Volume 2, Attachment 9 of the RI/FS Report), which equates to a cancer risk of 2E-06. Therefore, the excess cancer risks to the WRW from exposure to arsenic in surface soil/surface sediment in the UWOEU is similar to background risk.

### 4.2.6 Conclusion

The weight of evidence presented above shows that arsenic concentrations in UWOEU surface soil/surface sediment are not likely to be a result of historical site-related activities based on process knowledge, a spatial distribution that suggests arsenic is naturally occurring, probability plots that suggests the presence of single arsenic data populations which are also indicative of background conditions, UWOEU concentrations that are well within regional background levels, and UWOEU concentrations that are unlikely to result in risks to humans significantly above background risks. Arsenic is not considered a COC in surface soil/surface sediment for the UWOEU and, therefore, is not further evaluated quantitatively.

## 4.3 Benzo(a)pyrene

Benzo(a)pyrene in surface soil/surface sediment has a UCL greater than the PRG and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if benzo(a)pyrene should be retained for risk characterization are summarized below.

### 4.3.1 Summary of Process Knowledge

There are no documented historical source areas present in the UWOEU, and no documented operations or activities that occurred in UWOEU involving the use of benzo(a)pyrene (CDH 1992; DOE 1995; DOE 1992). Therefore, the potential for benzo(a)pyrene to be present in UWOEU surface soil/surface sediment as a result of historical site-related activities is unlikely.

### 4.3.2 Evaluation of Spatial Trends

***Surface Soil/Surface Sediment***

Benzo(a)pyrene was detected in 27 percent of the UWOEU surface soil/surface sediment samples. The detections are estimated values well below the reported detection limits of 330 to 400 micrograms per kilogram (µg/kg). As shown in Figure A3.4.2, there are several locations greater than the PRG that are located near an historical IHSS. Based on this line of evidence, benzo(a) Pyrene cannot be eliminated as a COC.

### 4.3.3 Conclusion

Although benzo(a)pyrene is not necessarily associated with site activities in the UWOEU, as a conservative measure, benzo(a)pyrene is carried forward into the risk characterization recognizing that its classification as a COC is uncertain.

## 4.4 Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if bis(2-ethylhexyl)phthalate should be retained for risk characterization are summarized below.

### 4.4.1 Summary of Process Knowledge

There are no documented historical source areas present in the UWOEU, and no documented operations or activities that occurred in UWOEU involving the use of bis(2-ethylhexyl)phthalate (CDH 1992; DOE 1995; DOE 1992). Therefore, the potential for bis(2-ethylhexyl)phthalate to be present in UWOEU surface soil as a result of historical site-related activities is unlikely.

### 4.4.2 Evaluation of Spatial Trends

*Surface Soil (non-PMJM)*

Bis(2-ethylhexyl)phthalate was detected in 27 percent of the UWOEU surface soil samples. The detections are estimated values well below the reported detection limit of 330 µg/kg. As shown in Figure A3.4.3, five of the 24 detections where the concentration is greater than the ESL are located near an historical IHSS. Based on this line of evidence, bis(2-ethylhexyl)phthalate cannot be eliminated as an ECOPC.

### 4.4.3 Conclusion

Although bis(2-ethylhexyl)phthalate is not necessarily associated with site activities in the UWOEU, as a conservative measure, bis(2-ethylhexyl)phthalate is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

## 4.5 Boron

Boron has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if boron should be retained for risk characterization are summarized below.

### 4.5.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates boron is unlikely to be present in RFETS soil as a result of historical site-related activities.

### 4.5.2 Evaluation of Spatial Trends

*Surface Soil (Non-PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis suggests that boron concentrations in UWOEU surface soil reflect variations in naturally occurring boron.

### 4.5.3 Pattern Recognition

*Surface Soil (Non-PMJM)*

The boron concentrations are normally distributed forming a single background population, which suggests background conditions (Figure A3.4.4).

### 4.5.4 Comparison to RFETS Background and Other Background Data Sets

*Surface Soil (Non-PMJM)*

The reported range for boron in surface soil within Colorado and the bordering states is 20 to 150 mg/kg, with a mean concentration of 27.9 mg/kg and a standard deviation of 19.7 mg/kg (Table A3.4.1). Boron concentrations reported in surface soil samples at the UWOEU are 3.90 to 11.0 mg/kg with a mean concentration of 5.21 mg/kg and a standard deviation of 2.79 mg/kg (Table A3.6). The range of concentrations of boron in surface soil is below the range for boron in soils of Colorado and the bordering states.

### 4.5.5 Risk Potential for Plants and Wildlife

*Surface Soil (Non-PMJM)*

The UTL for boron in the UWOEU (10.7 mg/kg) exceeds the NOAEL ESL for only one receptor group, terrestrial plants (0.5 mg/kg). All other NOAEL ESLs were greater than the UTL and ranged from 30.3 to 6,070 mg/kg. Site-specific background data for boron were not available, but the MDC did not exceed the low end (20 mg/kg) of the background range presented in Shacklette and Boerngen (1984). This indicates the terrestrial plant NOAEL ESL (0.5 mg/kg) is well below expected background concentrations, and because risks are not typically expected at background concentrations, boron concentrations are not likely to be indicative of site-related risk to the terrestrial plant community in the UWOEU. Kabata-Pendias and Pendias (1992) indicate soil with boron concentrations equal to 0.3 mg/kg is critically deficient in boron, and effects on plant reproduction would be expected. Additionally, the summary of boron toxicity in Efroymson et al. (1997) notes that the source of the 0.5-mg/kg NOAEL ESL indicates boron was toxic when added at 0.5 mg/kg to soil, but gives no indication of the boron concentration in the baseline soil before addition. The confidence placed by Efroymson et al. (1997) was low. Because no NOAEL ESLs other than the terrestrial plant NOAEL ESL are exceeded by the MDC, boron is unlikely to present a risk to terrestrial receptor populations in the UWOEU.

### 4.5.6 Conclusion

The weight of evidence presented above shows that boron concentrations in UWOEU surface soil (non-PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge; a spatial distribution that suggests boron is naturally occurring; a probability plot that suggests the presence of a single population, which is also indicative of background conditions; UWOEU concentrations that are well within regional background levels; and UWOEU concentrations that are unlikely to result in risk concerns for wildlife populations. Boron is not considered an ECOPC in surface soil for the UWOEU and, therefore, is not further evaluated quantitatively.

## 4.6 Chromium

Chromium in surface soil (for PMJM receptors) has concentrations statistically greater than background. The lines of evidence used to determine if chromium should be retained for risk characterization are summarized below.

### 4.6.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for chromium to have been released into RFETS soil because of the moderate chromium metal inventory and presence of chromium in waste generated during former operations. Spills of chromium contaminated wastes have also occurred at RFETS. Therefore, chromium may be present in UWOEU soil as a result of historical site-related activities.

### 4.6.2 Evaluation of Spatial Trends

*Surface Soil (PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevated chromium concentrations in UWOEU surface soil are located near historical IHSSs. Based on this line of evidence, chromium cannot be eliminated as an ECOPC.

### 4.6.3 Conclusion

Chromium in surface soil is being carried forward into the ecological PMJM risk characterization because elevated concentrations are located near an historic IHSS. Chromium was used in moderate quantities during historical RFETS operations, which would indicate it is a possible site-related contaminant. Therefore, chromium is carried forward into the risk characterization.

## 4.7 Copper

Copper in surface soil (for PMJM and non-PMJM receptors) has concentrations statistically greater than background, and an EPC that exceed the limiting tESLs for non-PMJM receptors, and was carried forward to the professional judgment step. The lines of evidence used to determine if copper should be retained for risk characterization are summarized below.

### 4.7.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates copper was used in relatively small quantities. Therefore copper is unlikely to be present in UWOEU soil as a result of historical site-related activities.

### 4.7.2 Evaluation of Spatial Trends

*Surface Soil (Non-PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that copper concentrations in UWOEU surface soil exceed three times the background MDC at locations near historical IHSSs. Based on this line of evidence, copper cannot be eliminated as an ECOPC.

*Surface Soil (PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that copper concentrations in UWOEU surface soil exceed three times the background MDC at locations near historical IHSSs. Based on this line of evidence, copper cannot be eliminated as an ECOPC.

### 4.7.3 Conclusion

Copper in surface soil is being carried forward into the ecological non-PMJM and PMJM risk characterization because elevated concentrations (greater than three times the background MDC) are near historic IHSSs. Copper was used in relatively small quantities during historical RFETS operations, which would indicate it is not likely to be a site-related contaminant. Nevertheless, as a conservative measure, copper is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

## 4.8 Di-n-butylphthalate

Di-n-butylphthalate has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if di-n-butylphthalate should be retained for risk characterization are summarized below.

### 4.8.1 Summary of Process Knowledge

There are no documented historical source areas present in the UWOEU, and no documented operations or activities that occurred in UWOEU involving the use of di-n-butylphthalate (CDH 1992; DOE 1995; DOE 1992). Therefore, the potential for di-n-butylphthalate to be present in UWOEU surface soil as a result of historical site-related activities is unlikely.

### 4.8.2 Evaluation of Spatial Trends

*Surface Soil (non-PMJM)*

Di-n-butylphthalate was detected in 11 percent of the UWOEU surface soil samples. The detections are estimated values well below the reported detection limit of 330 µg/kg. As shown in Figure A3.4.5, the detections occur randomly throughout the UWOEU, and all of the 10 detections were greater than the ESL.

### 4.8.3 Conclusion

Although di-n-butylphthalate is not necessarily associated with site activities in the UWOEU, as a conservative measure, di-n-butylphthalate is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

## 4.9 2,3,7,8-TCDD (TEQ)

2,3,7,8-TCDD (TEQ) have an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. 2,3,7,8-TCDD (TEQ) also has an EPC in surface soil/surface sediment greater than a PRG. The lines of evidence used to determine if 2,3,7,8-TCDD (TEQ) should be retained for risk characterization are summarized below.

### 4.9.1 Summary of Process Knowledge

There are no documented historical source areas present in the UWOEU involving the use or generation of dioxin (CDH 1992; DOE 1995; DOE 1992). Therefore, the potential for dioxin to be present in UWOEU surface soil as a result of historical site-related activities is unlikely.

### 4.9.2 Evaluation of Spatial Trends

*Surface Soil/Surface Sediment*

2,3,7,8 TCDD TEQ was detected in 27 percent of the UWOEU surface soil/surface sediment samples. The detections are estimated values well below the reported detection limits of 330 to 400 µg/kg. As shown on Figure A3.4.6, detections occur near historical IHSS and, therefore, cannot be eliminated as an ECOPC.

***Surface Soil (non-PMJM)***

2,3,7,8-TCDD (TEQ) (bird) was detected in the one UWOEU surface soil sample. The detections are estimated values well below the reported detection limit of 330 µg/kg. As shown in Figure A3.4.8, the detections occur randomly throughout the UWOEU, and all of the 10 detections were greater than the ESL. 2,3,7,8-TCDD (TEQ) (mammal) was detected in all of the UWOEU surface soil samples. The detections are estimated values well below the reported detection limit of 330 micrograms per kilogram (µg/kg). As shown in Figure A3.4.7, the detections occur near historical IHSS the UWOEU, and all of the 10 detections were greater than the ESL.

### 4.9.3 Conclusion

Although 2,3,7,8-TCDD (TEQ) is not necessarily associated with site activities in the UWOEU, a decision could not be made whether concentrations in samples collected from the UWOEU surface soil/surface sediment are significantly elevated compared to background because the background comparison is not performed for organics. Nevertheless, as a conservative measure, 2,3,7,8-TCDD (TEQ) is carried forward into the risk characterization recognizing that their classification as COCs/ECOPs is uncertain.

Although 2,3,7,8-TCDD (TEQ) (bird) is not necessarily associated with site activities in the UWOEU, as a conservative measure, 2,3,7,8-TCDD (TEQ) (bird) is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

Although 2,3,7,8-TCDD (TEQ) (mammal) is not necessarily associated with site activities in the UWOEU, as a conservative measure, 2,3,7,8-TCDD (TEQ) (mammal) is carried forward into the risk characterization recognizing that its classification as a COC and an ECOPC is uncertain.

## 4.10 Manganese

Manganese has concentrations statistically greater than background in surface soil (for PMJM receptors) in the UWOEU. Therefore, manganese in surface soil (for PMJM receptors) was carried forward to the professional judgment step. The lines of evidence used to determine if manganese should be retained for risk characterization are summarized below.

### 4.10.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, manganese was used in moderate quantities; however, process knowledge indicates manganese is unlikely to be present in RFETS soil as a result of historical site-related activities.

### 4.10.2 Evaluation of Spatial Trends

*Surface Soil (PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that manganese concentrations in UWOEU surface soil exceed the background MDC near historical IHSSs. Based on this line of evidence, manganese cannot be eliminated as an ECOPC.

### 4.10.3 Conclusion

Manganese in surface soil is being carried forward into the ecological PMJM risk characterization because elevated concentrations are located near historic IHSSs. Process knowledge indicates it is unlikely to be a site-related contaminant. Nevertheless, as a conservative measure, manganese is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

## 4.11 Molybdenum

Molybdenum has an EPC in surface soil for non-PMJM receptors greater than the limiting tESL and an MDC in surface soil for PMJM greater than the ESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if molybdenum should be retained for risk characterization are summarized below.

### 4.11.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, molybdenum was used in relatively small quantities and process knowledge indicates molybdenum is unlikely to be present in RFETS soil as a result of historical site-related activities.

### 4.11.2 Evaluation of Spatial Trends

*Surface Soil (non-PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that molybdenum concentrations in UWOEU surface soil reflect variations in naturally occurring molybdenum.

*Surface Soil (PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that molybdenum concentrations in UWOEU surface soil in PMJM habitat are elevated ear historical IHSSs. Based on this line of evidence, molybdenum concentrations near PMJM habitat cannot be eliminated as an ECOPC.

### 4.11.3 Pattern Recognition

*Surface Soil (non-PMJM)*

Molybdenum concentrations are lognormally distributed forming a single population (Figure A3.4.8). Molybdenum has multiple detection limits giving the distribution a stair-step characteristic in the lower concentrations. Multiple detection limit concentrations are shown on the probability plot as a suite of samples with the same concentration typically but not always in the lowest concentration range of the element.

### 4.11.4 Comparison to RFETS Background and Other Background Data Sets

*Surface Soil (Non-PMJM)*

The reported range for molybdenum in surface soil within Colorado and the bordering states is 3 to 7 mg/kg with a mean concentration of 1.59 mg/kg and a standard deviation of 0.522 mg/kg (Table A3.11). Molybdenum concentrations reported in surface soil samples at the UWOEU is 0.310 to 5.90 mg/kg with a mean concentration of 1.14 mg/kg and a standard deviation of 0.920 mg/kg (Table A3.6). The range of concentrations of molybdenum in surface soil is below the range for molybdenum in soils of Colorado and the bordering states.

### 4.11.5 Risk Potential for Plants and Wildlife

*Surface Soil (Non-PMJM)*

The UTL for molybdenum in the UWOEU (2.15 mg/kg) exceeds the NOAEL ESL for two receptor groups, terrestrial plants (2.0 mg/kg), and deer mouse insectivore (1.90 mg/kg). All other NOAEL ESLs were greater than the UTL and ranged from 6.97 to 275 mg/kg. Only the ESL for terrestrial plants is within the range of background concentrations. It is, therefore, likely to be overly conservative. None of the remaining ESLs are within the range of background concentrations and are not likely to be overly conservative for use in screening level risk assessments.

### 4.11.6 Conclusion

*Surface Soil (Non-PMJM)*

The weight of evidence presented above shows that molybdenum concentrations in UWOEU surface soil (non-PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge, a spatial distribution that suggests molybdenum is naturally occurring, a probability plot that suggests the presence of a single population which is also indicative of background conditions, and UWOEU concentrations that are well within regional background levels. Molybdenum is not considered an ECOPC in surface soil (for non-PMJM receptors) for the UWOEU, and therefore, is not further evaluated quantitatively.

*Surface Soil (PMJM)*

Molybdenum in surface soil is being carried forward into the ecological PMJM risk characterization as a conservative measure recognizing its classification as an ECOPC is uncertain.

## 4.12 Nickel

Nickel in surface soil (for PMJM and non-PMJM receptors) has concentrations statistically greater than background, and an EPC that exceed the limiting tESLs for non-PMJM receptors, and was carried forward to the professional judgment step. The lines of evidence used to determine if nickel should be retained for risk characterization are summarized below.

### 4.12.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for nickel to have been released into RFETS soil because of the moderate nickel metal inventory and presence of nickel in waste generated during former operations. Therefore, nickel may be present in UWOEU soil as a result of historical site-related activities.

### 4.12.2 Evaluation of Spatial Trends

*Surface Soil (non-PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that nickel concentrations in UWOEU surface soil exceed three times the background MDC at locations near historical IHSSs. Based on this line of evidence, nickel cannot be eliminated as an ECOPC.

*Surface Soil (PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that nickel concentrations in UWOEU surface soil exceed three times the background MDC at locations near historical IHSSs. Based on this line of evidence, nickel cannot be eliminated as an ECOPC.

### 4.12.3 Conclusion

Nickel in surface soil is being carried forward into the ecological non-PMJM and PMJM risk characterization because elevated concentrations (three times the background MDC) are located near a historic IHSSs. Nickel was used in moderate quantities during historical RFETS operations, and it may be present in RFETS soil as a result of historical site-related activities.

## 4.13 Silver

Silver had an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if silver should be retained for risk characterization are summarized below.

### 4.13.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for silver to have been released into RFETS soil because of silver in waste generated during former operations. Therefore, silver may be present in UWOEU soil as a result of historical site-related activities.

### 4.13.2 Evaluation of Spatial Trends

*Surface Soil (non-PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that silver concentrations in UWOEU surface soil exceed the minimum ESL at locations near historical IHSSs. Based on this line of evidence, silver cannot be eliminated as an ECOPC.

### 4.13.3 Conclusion

Silver in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations are located near a historic IHSSs. Also, silver may be present in RFETS soil as a result of historical site-related activities.

## 4.14 Tin

Tin has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. In addition, tin in surface soil (for PMJM receptors) has an MDC greater than the ESL, and was carried forward to the professional judgment step. The lines of evidence used to determine if tin should be retained for risk characterization are summarized below.

### 4.14.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for tin to have been released into RFETS soil because of the moderate tin metal inventory during former operations. Therefore, tin may be present in UWOEU soil as a result of historical site-related activities.

### 4.14.2 Evaluation of Spatial Trends

*Surface Soil (non-PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that tin concentrations in UWOEU surface soil exceed the minimum ESL at locations near historical IHSSs. Based on this line of evidence, tin cannot be eliminated as an ECOPC.

*Surface Soil (PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that tin concentrations in UWOEU surface soil exceed the minimum ESL at locations near historical IHSSs. Based on this line of evidence, tin cannot be eliminated as an ECOPC.

### 4.14.3 Conclusion

Tin in surface soil is being carried forward into the ecological non-PMJM and PMJM risk characterization because elevated concentrations are located near a historic IHSSs. Tin was used in moderate quantities during historical RFETS operations, and it may be present in RFETS soil as a result of historical site-related activities.

## 4.15 Total PCBs

Total PCBs have an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. In addition, total PCBs in surface soil (for PMJM receptors) has a MDC greater than the ESL, and was carried forward to the professional judgment step. The lines of evidence used to determine if total PCBs should be retained for risk characterization are summarized below.

### 4.15.1 Summary of Process Knowledge

There are no documented historical source areas present in the UWOEU, and no documented operations or activities that occurred in UWOEU involving the use of PCBs (CDH 1992; DOE 1995; DOE 1992). Therefore, the potential for PCBs to be present in UWOEU surface soil as a result of historical site-related activities is unlikely.

### 4.15.2 Evaluation of Spatial Trends

*Surface Soil (non-PMJM)*

Total PCBs were detected in 16 percent of the UWOEU surface soil samples. The detections are estimated values based on the reported detection limits of 1.4 to 160 µg/kg. As shown in Figure A3.4.10, detected results were greater than three times ESL at most locations. The samples are near an historical IHSS. Based on this line of evidence, total PCBs cannot be eliminated as an ECOPC.

*Surface Soil (PMJM)*

Total PCBs were detected in 32 percent of the UWOEU surface soil samples. The detections are estimated values based on reported detection limits of 1.4 to 160 µg/kg. As shown in Figure A3.4.11, there are 6 detections were greater than the ESL located near historical IHSS. Therefore, PCPs cannot be eliminated as an ECOPC.

### 4.15.3 Conclusion

Although total PCBs is not necessarily associated with site activities in the UWOEU, as a conservative measure, total PCBs is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

## 4.16 Uranium

Uranium has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if uranium should be retained for risk characterization are summarized below.

### 4.16.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for uranium to have been released into RFETS soil because of the large uranium metal inventory during former operations. Therefore, uranium may be present in UWOEU soil as a result of historical site-related activities.

### 4.16.2 Evaluation of Spatial Trends

*Surface Soil (non-PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that uranium concentrations in UWOEU surface soil exceed three times the minimum ESL at locations near historical IHSSs. Based on this line of evidence, uranium cannot be eliminated as an ECOPC.

### 4.16.3 Conclusion

Uranium in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations are located near an historic IHSS. Uranium was used in large quantities during historical RFETS operations, and it may be present in RFETS soil as a result of historical site-related activities.

## 4.17 Vanadium

Vanadium has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL, and therefore, was carried forward to the professional judgment step. In addition, vanadium in surface soil (for PMJM receptors) has concentrations statistically greater than background, and was carried forward to the professional judgment step. The lines of evidence used to determine if vanadium should be retained for risk characterization are summarized below.

### 4.17.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates vanadium is unlikely to be present in RFETS soil as a result of historical site-related activities.

### 4.17.2 Evaluation of Spatial Trends

***Surface Soil (non-PMJM)***

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that vanadium concentrations in UWOEU surface soil exceed the background MDC at locations near historical IHSSs. Based on this line of evidence, vanadium cannot be eliminated as an ECOPC.

***Surface Soil (PMJM)***

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that vanadium concentrations in UWOEU surface soil exceed the background MDC at locations near historical IHSSs. Based on this line of evidence, vanadium cannot be eliminated as an ECOPC.

### 4.17.3 Conclusion

***Surface Soil (Non-PMJM and Non-PMJM))***

Vanadium in surface soil is being carried forward into the ecological non-PMJM and PMJM risk characterization as a conservative measure recognizing that its classification as an ECOPC is uncertain.

## 4.18 Zinc

Zinc has concentrations statistically greater than background in surface soil (for PMJM receptors) in the UWOEU. Therefore, zinc in surface soil (for PMJM receptors) was carried forward to the professional judgment step. The lines of evidence used to determine if zinc should be retained for risk characterization are summarized below.

### 4.18.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, zinc was used in moderate quantities. However, zinc was not identified or discussed in building process information, and has not been found associated with UBC building processes. Base process knowledge indicates zinc is unlikely to be present in RFETS soil as a result of historical site-related activities.

### 4.18.2 Evaluation of Spatial Trends

*Surface Soil (PMJM)*

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that zinc concentrations in UWOEU surface soil exceed the background MDC at locations near historical IHSSs. Based on this line of evidence, zinc cannot be eliminated as an ECOPC.

### 4.18.3 Conclusion

Zinc in surface soil is being carried forward into the ecological PMJM risk characterization because elevated concentrations are located near historic IHSSs. Process knowledge indicates it is unlikely to be a site-related contaminant. Nevertheless, as a conservative measure, zinc is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

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# TABLES

Table A3.2.1

Statistical Distributions and Comparison to Background for UWOEU Surface Soil/ Surface Sediment

| Analyte | Statistical Distribution Testing Results | | | | | | Background Comparison Test Results | | |
|---|---|---|---|---|---|---|---|---|---|
| | Background Dataset | | | UWOEU Dataset (excluding background samples) | | | | | |
| | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Test | 1 - p | Statistically Greater than Background? |
| **Arsenic** | **20** | **NORMAL** | **92** | **130** | **NORMAL** | **99** | **t-Test_N** | **1.38E-05** | **Yes** |
| Cesium-134 | 70 | NON-PARAMETRIC | 100 | N/A | N/A | 100 | WRS | 9.00E-01 | No |
| Cesium-137 | 70 | NORMAL | 100 | 1 | 0 | 100 | WRS | 1.00E+00 | No |
| Radium-228 | 20 | NORMAL | 100 | 4 | NORMAL | 100 | t-Test_N | 6.51E-01 | No |

WRS = Wilcoxon Rank Sum

t-Test_N = Student's t-test using normal data

**Bolded entries indicated analytes retained for further consideration in the next COC selection step.**

**Table A3.2.2**

**Summary Statistics for Background and UWOEU Surface Soil/ Surface Sediment[a]**

| Analyte | Units | Background Dataset | | | | | UWOEU Dataset (excluding background samples) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Samples | Minimum Detected Concentration | Maximum Detected Concentration | Mean Concentration | Standard Deviation | Total Samples | Minimum Detected Concentration | Maximum Detected Concentration | Mean Concentration | Standard Deviation |
| Aluminum | mg/kg | 73 | 811 | 25,200 | 7,712 | 5,349 | 161 | 1,140 | 30,200 | 10,799 | 5,267 |
| Antimony | mg/kg | 66 | 1.00 | 12.4 | 2.64 | 3.12 | 148 | 0.330 | 51.3 | 5.68 | 8.25 |
| Arsenic | mg/kg | 73 | 0.270 | 9.60 | 3.42 | 2.55 | 161 | 0.290 | 27.9 | 5.07 | 3.05 |
| Chromium | mg/kg | 73 | 1.50 | 30.4 | 9.21 | 6.69 | 161 | 1.50 | 70.1 | 13.0 | 8.22 |
| Iron | mg/kg | 73 | 1,040 | 31,400 | 10,433 | 6,064 | 161 | 2,660 | 38,800 | 14,077 | 5,227 |
| Manganese | mg/kg | 73 | 9.00 | 1,280 | 241 | 189 | 161 | 45.2 | 829 | 258 | 116 |
| Benzo(a)anthracene | ug/kg | 62 | 37.0 | 1,700 | 408 | 281 | 111 | 22.0 | 45,000 | 755 | 4,269 |
| Benzo(a)pyrene | ug/kg | 62 | 120 | 900 | 389 | 217 | 121 | 37.0 | 43,000 | 702 | 3,904 |
| Dibenz(a,h)anthracene | ug/kg | 62 | 220 | 220 | 386 | 211 | 104 | 60.0 | 9,200 | 329 | 889 |
| Indeno(1,2,3-cd)pyrene | ug/kg | 61 | 220 | 470 | 376 | 202 | 106 | 24.0 | 32,000 | 575 | 3,097 |
| PCB-1254 | ug/kg | 59 | 19.0 | 58.0 | 262 | 635 | 115 | 19.0 | 3,900 | 282 | 541 |
| Cesium-134 | pCi/g | 77 | 1.00E-03 | 0.300 | 0.141 | 0.066 | 13 | 1.00E-03 | 0.300 | 0.093 | 0.091 |
| Cesium-137 | pCi/g | 105 | -0.027 | 1.80 | 0.692 | 0.492 | 22 | 0.030 | 1.00 | 0.173 | 0.201 |
| Plutonium-239/240 | pCi/g | 94 | -0.010 | 0.350 | 0.032 | 0.039 | 214 | -0.013 | 17.1 | 0.230 | 1.23 |
| Radium-228 | pCi/g | 40 | 0.200 | 4.10 | 1.60 | 0.799 | 8 | 0.880 | 2.29 | 1.41 | 0.483 |
| Uranium-233/234 | pCi/g | 65 | 0.136 | 4.78 | 1.49 | 0.982 | 188 | 0.191 | 47.5 | 1.43 | 3.55 |
| Uranium-235 | pCi/g | 64 | 0 | 0.191 | 0.058 | 0.041 | 188 | -0.023 | 2.24 | 0.086 | 0.228 |
| Uranium-238 | pCi/g | 65 | 0.127 | 3.82 | 1.36 | 0.825 | 188 | 0.283 | 209 | 3.11 | 16.5 |

[a] Statistics are computed using one-half the reported value for nondetects.

Table A3.2.3
Statistical Distributions and Comparison to Background for UWOEU Subsurface Soil/ Subsurface Sediment

| Analyte | Statistical Distribution Testing Results | | | | | | Background Comparison Test Results | | |
|---|---|---|---|---|---|---|---|---|---|
| | Background Dataset | | | UWOEU Dataset (excluding background samples) | | | | | |
| | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Test | 1 - p | Statistically Greater than Background? |
| Radium-228 | 31 | GAMMA | 100 | 26 | NORMAL | 100 | WRS | 0.170 | No |

WRS = Wilcoxon Rank Sum

**Table A3.2.4**
**Summary Statistics for Background and UWOEU Subsurface Soil/ Subsurface Sediment[a]**

| Analyte | Units | Background Dataset | | | | | UWOEU Dataset (excluding background samples) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Samples | Minimum Detected Concentration | Maximum Detected Concentration | Mean Concentration | Standard Deviation | Total Samples | Minimum Detected Concentration | Maximum Detected Concentration | Mean Concentration | Standard Deviation |
| Radium-228 | pCi/g | 31 | 1.00 | 2.10 | 1.45 | 0.320 | 26 | 0 | 2.79 | 1.55 | 0.577 |

[a] Statistics are computed using one-half the reported value for nondetects.

**Table A3.2.5**
**Statistical Distributions and Comparison to Background for UWOEU Surface Soil (non-PMJM)**

| Analyte | Statistical Distribution Testing Results | | | | | | Background Comparison Test Results | | |
|---|---|---|---|---|---|---|---|---|---|
| | Background Dataset | | | UWOEU Dataset (excluding background samples) | | | | | |
| | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Test | 1 - p | Statistically Greater than Background? |
| Aluminum | 20 | NORMAL | 100 | 130 | GAMMA | 100 | WRS | 0.364 | No |
| **Antimony** | **20** | **NON-PARAME** | **0** | **120** | **NON-PARAM** | **7** | **N/A** | **N/A** | **N/A** |
| Arsenic | 20 | NORMAL | 100 | 130 | NORMAL | 100 | t-Test_N | 0.978 | No |
| **Barium** | **20** | **NORMAL** | **100** | **130** | **GAMMA** | **100** | **WRS** | **0.033** | **Yes** |
| **Boron** | **N/A** | **N/A** | **N/A** | **18** | **NORMAL** | **72** | **N/A** | **N/A** | **N/A** |
| Cadmium | 20 | NON-PARAME | 65 | 120 | NON-PARAM | 31 | WRS | 0.995 | No |
| Chromium | 20 | NORMAL | 100 | 130 | GAMMA | 99 | WRS | 0.187 | No |
| Cobalt | 20 | NORMAL | 100 | 130 | NORMAL | 88 | t-Test_N | 0.416 | No |
| **Copper** | **20** | **NON-PARAME** | **100** | **130** | **NON-PARAM** | **99** | **WRS** | **0.012** | **Yes** |
| Lead | 20 | NORMAL | 100 | 135 | LOGNORMAL | 100 | WRS | 1.000 | No |
| Lithium | 20 | NORMAL | 100 | 128 | GAMMA | 92 | WRS | 0.541 | No |
| Manganese | 20 | NORMAL | 100 | 130 | GAMMA | 100 | WRS | 0.285 | No |
| Mercury | 20 | NON-PARAME | 40 | 128 | NON-PARAM | 47 | WRS | 0.898 | No |
| **Molybdenum** | **20** | **NORMAL** | **0** | **128** | **NON-PARAM** | **19** | **N/A** | **N/A** | **N/A** |
| **Nickel** | **20** | **NORMAL** | **100** | **129** | **NON-PARAM** | **96** | **WRS** | **5.40E-04** | **Yes** |
| Selenium | 20 | NON-PARAME | 60 | 120 | NON-PARAM | 36 | WRS | 1.000 | No |
| **Silver** | **20** | **NORMAL** | **0** | **117** | **NON-PARAM** | **24** | **N/A** | **N/A** | **N/A** |
| **Tin** | **20** | **NORMAL** | **0** | **129** | **NON-PARAM** | **12** | **N/A** | **N/A** | **N/A** |
| **Uranium** | **N/A** | **N/A** | **N/A** | **18** | **NON-PARAM** | **39** | **N/A** | **N/A** | **N/A** |
| **Vanadium** | **20** | **NORMAL** | **100** | **130** | **GAMMA** | **100** | **WRS** | **0.096** | **Yes** |
| Zinc | 20 | NORMAL | 100 | 130 | NON-PARAM | 100 | WRS | 0.456 | No |

t-Test_N = Student's t-test using normal data
WRS = Wilcoxon Rank Sum
N/A = not applicable; site and/or background detection frequency less than 20%.
**Bolded entries indicated analytes retained for further consideration in the next ECOPC selection step.**

## Table A3.2.6
### Summary Statistics for Background and UWOEU Surface Soil (non-PMJM)[a]

| Analyte | Units | Background Dataset | | | | | UWOEU Dataset (excluding background samples) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Samples | Minimum Detected Concentration | Maximum Detected Concentration | Mean Concentration | Standard Deviation | Total Samples | Minimum Detected Concentration | Maximum Detected Concentration | Mean Concentration | Standard Deviation |
| Aluminum | mg/kg | 20 | 4,050 | 17,100 | 10,203 | 3,256 | 130 | 1,950 | 30,000 | 11,069 | 4,969 |
| Antimony | mg/kg | 20 | ND | ND | 0.279 | 0.078 | 120 | 0.330 | 49.8 | 4.53 | 5.84 |
| Arsenic | mg/kg | 20 | 2.30 | 9.60 | 6.09 | 2.00 | 130 | 0.290 | 10.0 | 5.06 | 2.11 |
| Barium | mg/kg | 20 | 45.7 | 134 | 102 | 19.4 | 130 | 40.1 | 464 | 122 | 51.2 |
| Boron | mg/kg | N/A | N/A | N/A | N/A | N/A | 18 | 3.90 | 11.0 | 5.21 | 2.79 |
| Cadmium | mg/kg | 20 | 0.670 | 2.30 | 0.708 | 0.455 | 120 | 0.270 | 30.0 | 0.777 | 2.76 |
| Chromium | mg/kg | 20 | 5.50 | 16.9 | 11.2 | 2.78 | 130 | 2.60 | 61.0 | 13.1 | 6.91 |
| Cobalt | mg/kg | 20 | 3.40 | 11.2 | 7.27 | 1.79 | 130 | 2.40 | 13.7 | 7.39 | 2.31 |
| Copper | mg/kg | 20 | 5.20 | 16.0 | 13.0 | 2.58 | 130 | 5.10 | 330 | 24.6 | 36.3 |
| Lead | mg/kg | 20 | 8.60 | 53.3 | 33.5 | 10.5 | 135 | 5.80 | 220 | 26.4 | 22.7 |
| Lithium | mg/kg | 20 | 4.80 | 11.6 | 7.66 | 1.89 | 128 | 2.40 | 20.0 | 7.93 | 3.52 |
| Manganese | mg/kg | 20 | 129 | 357 | 237 | 63.9 | 130 | 45.2 | 829 | 261 | 112 |
| Mercury | mg/kg | 20 | 0.090 | 0.120 | 0.072 | 0.031 | 128 | 0.017 | 2.40 | 0.091 | 0.217 |
| Molybdenum | mg/kg | 20 | ND | ND | 0.573 | 0.184 | 128 | 0.310 | 5.90 | 1.14 | 0.920 |
| Nickel | mg/kg | 20 | 3.80 | 14.0 | 9.60 | 2.59 | 129 | 4.70 | 48.0 | 13.2 | 5.71 |
| Selenium | mg/kg | 20 | 0.680 | 1.40 | 0.628 | 0.305 | 120 | 0.220 | 1.00 | 0.283 | 0.194 |
| Silver | mg/kg | 20 | ND | ND | 0.207 | 0.007 | 117 | 0.095 | 98.0 | 2.47 | 12.5 |
| Tin | mg/kg | 20 | ND | ND | 2.06 | 0.410 | 129 | 1.20 | 66.9 | 6.28 | 11.7 |
| Uranium | mg/kg | N/A | N/A | N/A | N/A | N/A | 18 | 1.80 | 85.0 | 8.60 | 20.1 |
| Vanadium | mg/kg | 20 | 10.8 | 45.8 | 27.7 | 7.68 | 130 | 9.90 | 54.8 | 30.7 | 8.87 |
| Zinc | mg/kg | 20 | 21.1 | 75.9 | 49.8 | 12.2 | 130 | 11.8 | 650 | 65.5 | 71.0 |
| 2-Methylnaphthalene | ug/kg | N/A | N/A | N/A | N/A | N/A | 88 | 57.0 | 12,000 | 406 | 1,256 |
| 4,4'-DDT | ug/kg | N/A | N/A | N/A | N/A | N/A | 89 | 21.0 | 21.0 | 14.5 | 10.2 |
| Acenaphthene | ug/kg | N/A | N/A | N/A | N/A | N/A | 101 | 51.0 | 44,000 | 765 | 4,355 |
| Benzo(a)pyrene | ug/kg | N/A | N/A | N/A | N/A | N/A | 98 | 60.0 | 43,000 | 810 | 4,334 |
| bis(2-ethylhexyl)phthalate | ug/kg | N/A | N/A | N/A | N/A | N/A | 89 | 48.0 | 3,500 | 273 | 367 |
| Dieldrin | ug/kg | N/A | N/A | N/A | N/A | N/A | 89 | 34.0 | 34.0 | 14.9 | 10.5 |
| Di-n-butylphthalate | ug/kg | N/A | N/A | N/A | N/A | N/A | 89 | 40.0 | 200 | 250 | 111 |
| Endrin ketone | ug/kg | N/A | N/A | N/A | N/A | N/A | 89 | 36.0 | 36.0 | 14.7 | 10.5 |
| Fluorene | ug/kg | N/A | N/A | N/A | N/A | N/A | 106 | 39.0 | 39,000 | 614 | 3,771 |
| 2,3,7,8-TCDD TEQ (Mammal) | ug/kg | N/A | N/A | N/A | N/A | N/A | 10 | 4.87E-08 | 0.074 | 0.011 | 0.023 |
| 2,3,7,8-TCDD TEQ (Bird) | ug/kg | N/A | N/A | N/A | N/A | N/A | 1 | 0.004 | 0.004 | 0.004 | N/A |
| Naphthalene | ug/kg | N/A | N/A | N/A | N/A | N/A | 113 | 0.950 | 41,000 | 696 | 3,839 |
| Total PCBs | ug/kg | N/A | N/A | N/A | N/A | N/A | 90 | 220 | 3,900 | 331 | 602 |

[a] Statistics are computed using one-half the reported value for nondetects.
N/A = Not available.
ND = Analyte not detected.

**Table A3.2.7**
**Statistical Distributions and Comparison to Background for UWOEU Surface Soil (PMJM)**

| Analyte | Statistical Distribution Testing Results | | | | | | Background Comparison Test Results | | |
|---|---|---|---|---|---|---|---|---|---|
| | Background Dataset | | | UWOEU Dataset (excluding background samples) | | | | | |
| | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Total Samples | Distribution Recommended by ProUCL | Detects (%) | Test | 1 - p | Statistically Greater than Background? |
| **Antimony** | **20** | **NON-PARAMETRIC** | **0.0** | **29** | **NON-PARAMETRIC** | **13.79** | **N/A** | **N/A** | **N/A** |
| Arsenic | 20 | NORMAL | 100.0 | 34 | NORMAL | 100.00 | t-Test_N | 0.951 | No |
| Cadmium | 20 | NON-PARAMETRIC | 65.0 | 32 | NON-PARAMETRIC | 34.38 | WRS | 0.856 | No |
| **Chromium** | **20** | **NORMAL** | **100.0** | **34** | **NORMAL** | **100.00** | **t-Test_N** | **0.003** | **Yes** |
| **Copper** | **20** | **NON-PARAMETRIC** | **100.0** | **34** | **NON-PARAMETRIC** | **100.00** | **WRS** | **0.002** | **Yes** |
| **Manganese** | **20** | **NORMAL** | **100.0** | **34** | **GAMMA** | **100.00** | **WRS** | **0.017** | **Yes** |
| Mercury | 20 | NON-PARAMETRIC | 40.0 | 33 | NON-PARAMETRIC | 57.58 | WRS | 0.609 | No |
| **Molybdenum** | **20** | **NORMAL** | **0.0** | **33** | **LOGNORMAL** | **18.18** | **N/A** | **N/A** | **N/A** |
| **Nickel** | **20** | **NORMAL** | **100.0** | **33** | **NORMAL** | **90.91** | **t-Test_N** | **9.00E-04** | **Yes** |
| Selenium | 20 | NON-PARAMETRIC | 60.0 | 33 | NON-PARAMETRIC | 39.39 | WRS | 1.000 | No |
| **Tin** | **20** | **NORMAL** | **0.0** | **34** | **LOGNORMAL** | **17.65** | **N/A** | **N/A** | **N/A** |
| **Vanadium** | **20** | **NORMAL** | **100.0** | **34** | **NORMAL** | **100.00** | **t-Test_N** | **0.017** | **Yes** |
| **Zinc** | **20** | **NORMAL** | **100.0** | **34** | **LOGNORMAL** | **100.00** | **WRS** | **0.010** | **Yes** |

t-Test_N = Student's t-test using normal data
WRS = Wilcoxon Rank Sum
N/A = not applicable; site and/or background detection frequency less than 20%.
**Bolded entries indicated analytes retained for further consideration in the next ECOPC selection step.**

**Table A3.2.8**
**Summary Statistics for Background and UWOEU Surface Soil (PMJM)[a]**

| Analyte | Units | Background Dataset | | | | | UWOEU Dataset (excluding background samples) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Samples | Minimum Detected Concentration | Maximum Detected Concentration | Mean Concentration | Standard Deviation | Total Samples | Minimum Detected Concentration | Maximum Detected Concentration | Mean Concentration | Standard Deviation |
| Antimony | mg/kg | 20 | ND | ND | 0.279 | 0.078 | 29 | 0.330 | 49.8 | 7.06 | 10.8 |
| Arsenic | mg/kg | 20 | 2.30 | 9.60 | 6.09 | 2.00 | 34 | 1.90 | 9.90 | 5.25 | 1.60 |
| Cadmium | mg/kg | 20 | 0.670 | 2.30 | 0.708 | 0.455 | 32 | 0.420 | 4.10 | 0.734 | 0.834 |
| Chromium | mg/kg | 20 | 5.50 | 16.9 | 11.2 | 2.78 | 34 | 2.60 | 26.0 | 15.1 | 5.52 |
| Copper | mg/kg | 20 | 5.20 | 16.0 | 13.0 | 2.58 | 34 | 5.10 | 112 | 26.4 | 25.5 |
| Manganese | mg/kg | 20 | 129 | 357 | 237 | 63.9 | 34 | 134 | 829 | 319 | 141 |
| Mercury | mg/kg | 20 | 0.090 | 0.120 | 0.072 | 0.031 | 33 | 0.027 | 0.370 | 0.092 | 0.092 |
| Molybdenum | mg/kg | 20 | ND | ND | 0.573 | 0.184 | 33 | 0.840 | 4.40 | 1.18 | 0.784 |
| Nickel | mg/kg | 20 | 3.80 | 14.0 | 9.60 | 2.59 | 33 | 5.70 | 26.3 | 13.6 | 5.03 |
| Selenium | mg/kg | 20 | 0.680 | 1.40 | 0.628 | 0.305 | 33 | 0.220 | 1.00 | 0.277 | 0.204 |
| Tin | mg/kg | 20 | ND | ND | 2.06 | 0.410 | 34 | 1.60 | 66.9 | 10.3 | 16.1 |
| Vanadium | mg/kg | 20 | 10.8 | 45.8 | 27.7 | 7.68 | 34 | 9.90 | 53.0 | 33.6 | 10.5 |
| Zinc | mg/kg | 20 | 21.1 | 75.9 | 49.8 | 12.2 | 34 | 21.2 | 199 | 73.4 | 41.1 |
| Total PCBs | ug/kg | N/A | N/A | N/A | N/A | N/A | 19 | 150 | 4,230 | 1,138 | 1,153 |

[a] Statistics are computed using one-half the reported value for nondetects.
N/A = Not available.
ND = Analyte not detected.

**Table A3.2.9**
**Statistical Distributions and Comparison to Background for UWOEU Subsurface Soil**

| Analyte | Statistical Distribution Testing Results: Background Dataset: Total Samples | Background Dataset: Distribution Recommended by ProUCL | Background Dataset: Detects (%) | UWOEU Dataset (excluding background samples): Total Samples | UWOEU Dataset: Distribution Recommended by ProUCL | UWOEU Dataset: Detects (%) | Background Comparison Test Results: Test | 1 - p | Statistically Greater than Background? |
|---|---|---|---|---|---|---|---|---|---|
| **Antimony** | **28** | **NON-PARAMETRIC** | **7** | **229** | **NON-PARAMETRIC** | **21** | **N/A** | **N/A** | **N/A** |
| Arsenic | 45 | NON-PARAMETRIC | 93 | 252 | NON-PARAMETRIC | 100 | WRS | 0.760 | No |
| Beryllium | 45 | GAMMA | 96 | 257 | NON-PARAMETRIC | 76 | WRS | 1.00 | No |
| Chromium | 45 | GAMMA | 100 | 252 | NON-PARAMETRIC | 100 | WRS | 0.794 | No |
| **Copper** | **45** | **NORMAL** | **96** | **252** | **NON-PARAMETRIC** | **97** | **WRS** | **4.49E-07** | **Yes** |
| Lead | 45 | GAMMA | 100 | 257 | NON-PARAMETRIC | 100 | WRS | 0.102 | No |
| **Manganese** | **45** | **GAMMA** | **100** | **252** | **GAMMA** | **100** | **WRS** | **6.70E-05** | **Yes** |
| Molybdenum | 45 | NON-PARAMETRIC | 67 | 251 | NON-PARAMETRIC | 24 | WRS | 1.00 | No |
| Nickel | 44 | GAMMA | 100 | 252 | NON-PARAMETRIC | 96 | WRS | 0.979 | No |
| **Selenium** | **38** | **LOGNORMAL** | **0** | **247** | **NON-PARAMETRIC** | **14** | **N/A** | **N/A** | **N/A** |
| **Tin** | **41** | **NON-PARAMETRIC** | **37** | **251** | **NON-PARAMETRIC** | **9** | **N/A** | **N/A** | **N/A** |
| **Zinc** | **44** | **NORMAL** | **100** | **252** | **NON-PARAMETRIC** | **100** | **WRS** | **4.86E-04** | **Yes** |

WRS = Wilcoxon Rank Sum
N/A = not applicable; site and/or background detection frequency less than 20%.
**Bolded entries indicated analytes retained for further consideration in the next ECOPC selection step.**

Table A3.2.10

Summary Statistics for Background and UWOEU Subsurface Soil[a]

| Analyte | Units | Background Dataset | | | | | UWOEU Dataset (excluding background samples) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Samples | Minimum Detected Concentration | Maximum Detected Concentration | Mean Concentration | Standard Deviation | Total Samples | Minimum Detected Concentration | Maximum Detected Concentration | Mean Concentration | Standard Deviation |
| Antimony | mg/kg | 28 | 2.90 | 8.20 | 4.21 | 2.78 | 229 | 0.340 | 149 | 7.00 | 11.9 |
| Arsenic | mg/kg | 45 | 1.70 | 41.8 | 5.48 | 6.02 | 252 | 0.470 | 24.3 | 4.68 | 2.82 |
| Beryllium | mg/kg | 45 | 1.00 | 22.4 | 5.76 | 5.01 | 257 | 0.280 | 446 | 3.61 | 29.3 |
| Chromium | mg/kg | 45 | 5.80 | 69.6 | 18.4 | 11.9 | 252 | 4.30 | 8,310 | 53.0 | 523 |
| Copper | mg/kg | 45 | 2.20 | 31.6 | 11.6 | 6.09 | 252 | 3.60 | 8,850 | 140 | 761 |
| Lead | mg/kg | 45 | 4.20 | 25.8 | 13.9 | 6.31 | 257 | 2.90 | 5,200 | 60.9 | 344 |
| Manganese | mg/kg | 45 | 16.0 | 747 | 171 | 158 | 252 | 14.3 | 2,150 | 279 | 253 |
| Molybdenum | mg/kg | 45 | 3.50 | 41.0 | 13.5 | 7.80 | 251 | 0.320 | 470 | 5.06 | 33.2 |
| Nickel | mg/kg | 44 | 4.30 | 54.2 | 20.9 | 11.1 | 252 | 2.70 | 4,750 | 40.3 | 299 |
| Selenium | mg/kg | 38 | ND | ND | 0.592 | 0.543 | 247 | 0.150 | 80.8 | 0.569 | 5.15 |
| Tin | mg/kg | 41 | 25.7 | 441 | 86.0 | 134 | 251 | 1.50 | 579 | 8.73 | 38.7 |
| Zinc | mg/kg | 44 | 0.520 | 79.8 | 36.2 | 21.0 | 252 | 7.60 | 6,920 | 137 | 510 |

[a] Statistics are computed using one-half the reported value for nondetects.

ND = Analyte not detected.

**Table A3.4.1**

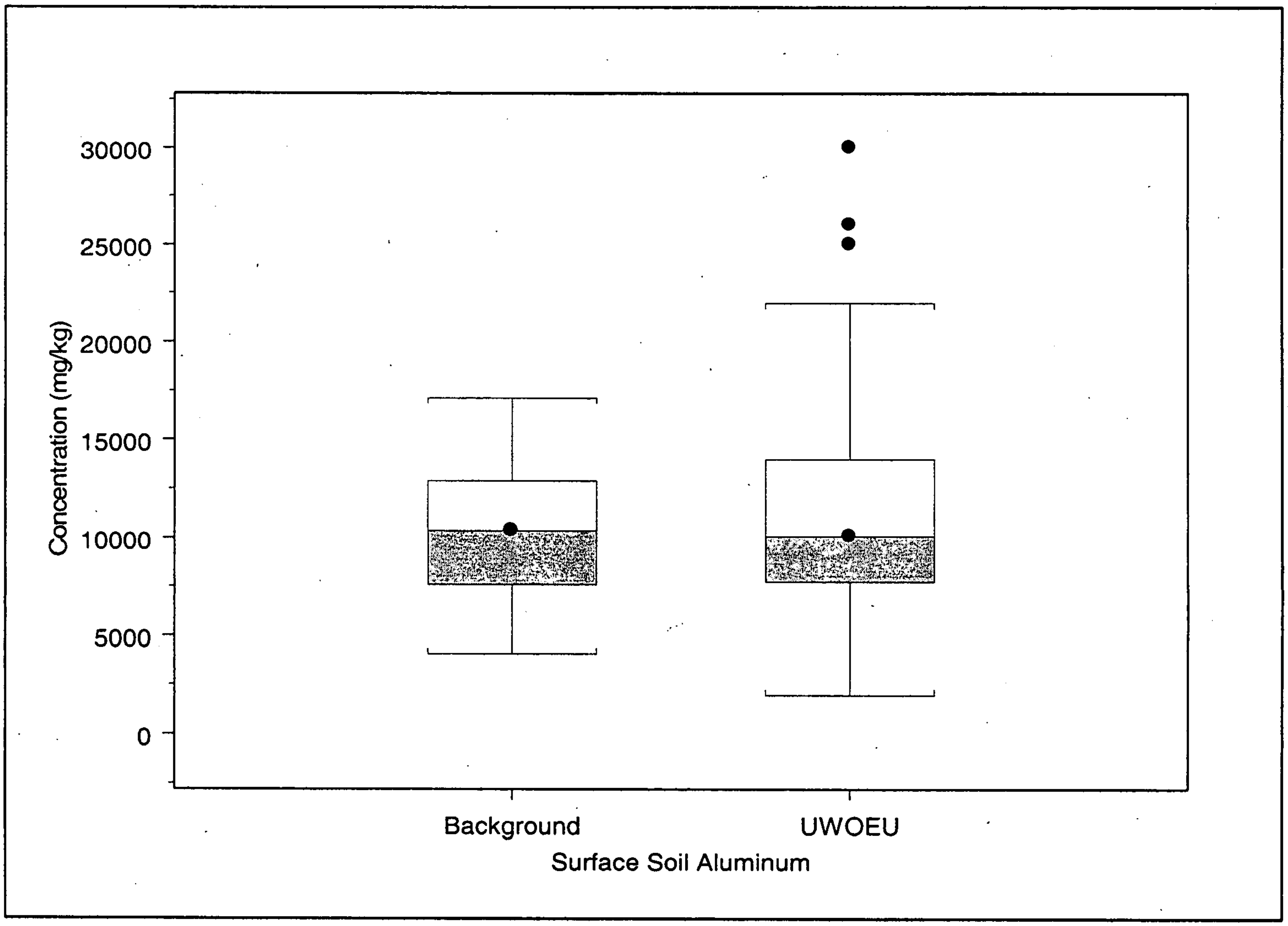
**Summary of Element Soil Concentrations in Colorado and Bordering States[a]**

| Analyte | Total Number of Results | Detection Frequency (%) | Range of Detected Values (mg/kg) | Average (mg/kg)[b] | Standard Deviation (mg/kg)[b] |
|---|---|---|---|---|---|
| Aluminum | 303 | 100 | 5,000 - 100,000 | 50,800 | 23,500 |
| Antimony | 84 | 15.5 | 1.038 - 2.531 | 0.647 | 0.378 |
| Arsenic | 307 | 99.3 | 1.224 - 97 | 6.9 | 7.64 |
| Barium | 342 | 100 | 100 - 3,000 | 642 | 330 |
| Beryllium | 342 | 36.0 | 1 - 7 | 0.991 | 0.876 |
| Boron | 342 | 66.7 | 20 - 150 | 27.9 | 19.7 |
| Bromine | 85 | 50.6 | 0.5038 - 3.522 | 0.681 | 0.599 |
| Calcium | 342 | 100 | 0.055 - 32 | 3.09 | 4.13 |
| Carbon | 85 | 100 | 0.3 - 10 | 2.18 | 1.92 |
| Cerium | 291 | 16.2 | 150 - 300 | 90 | 38.4 |
| Chromium | 342 | 100 | 3 - 500 | 48.2 | 41 |
| Cobalt | 342 | 88.6 | 3 - 30 | 8.09 | 5.03 |
| Copper | 342 | 100 | 2 - 200 | 23.1 | 17.7 |
| Fluorine | 264 | 97.3 | 10 - 1,900 | 394 | 261 |
| Gallium | 340 | 99.1 | 5 - 50 | 18.3 | 8.9 |
| Germanium | 85 | 100 | 0.578 - 2.146 | 1.18 | 0.316 |
| Iodine | 85 | 78.8 | 0.516 - 3.487 | 1.07 | 0.708 |
| Iron | 342 | 100 | 3,000 - 100,000 | 21,100 | 13,500 |
| Lanthanum | 341 | 66.3 | 30 - 200 | 39.8 | 28.8 |
| Lead | 342 | 92.7 | 10 - 700 | 24.8 | 41.5 |
| Lithium | 307 | 100 | 5 - 130 | 25.3 | 14.4 |
| Magnesium | 341 | 100 | 300 - 50,000 | 8,630 | 6,400 |
| Manganese | 342 | 100 | 70 - 2,000 | 414 | 272 |
| Mercury | 309 | 99.0 | 0.01 - 4.6 | 0.0768 | 0.276 |
| Molybdenum | 340 | 3.53 | 3 - 7 | 1.59 | 0.522 |
| Neodymium | 256 | 22.7 | 70 - 300 | 47.1 | 31.7 |
| Nickel | 342 | 96.5 | 5 - 700 | 18.8 | 39.8 |
| Niobium | 335 | 63.3 | 10 - 100 | 11.4 | 8.68 |
| Phosphorus | 249 | 100 | 40 - 4,497 | 399 | 397 |
| Potassium | 341 | 100 | 1,900 - 63,000 | 18,900 | 6,980 |
| Rubidium | 85 | 100 | 35 - 140 | 75.8 | 25 |
| Scandium | 342 | 85.1 | 5 - 30 | 8.64 | 4.69 |
| Selenium | 309 | 80.6 | 0.1023 - 4.3183 | 0.349 | 0.415 |
| Silicon | 85 | 100 | 149,340 - 413,260 | 302,000 | 61,500 |
| Sodium | 335 | 100 | 500 - 70,000 | 10,400 | 6,260 |
| Strontium | 342 | 100 | 10 - 2,000 | 243 | 212 |
| Sulfur | 85 | 16.5 | 816 - 47,760 | 1,250 | 5,300 |
| Thallium | 76 | 100 | 2.45 - 20.79 | 9.71 | 3.54 |
| Tin | 85 | 96.5 | 0.117 - 5.001 | 1.15 | 0.772 |
| Titanium | 342 | 100 | 500 - 7,000 | 2,290 | 1,350 |
| Uranium | 85 | 100 | 1.11 - 5.98 | 2.87 | 0.883 |
| Vanadium | 342 | 100 | 7 - 300 | 73 | 41.7 |
| Ytterbium | 330 | 99.1 | 1 - 20 | 3.33 | 2.06 |
| Yttrium | 342 | 98.0 | 10 - 150 | 26.9 | 18.1 |
| Zinc | 330 | 100 | 10 - 2,080 | 72.4 | 159 |
| Zirconium | 342 | 100 | 30 - 1,500 | 220 | 157 |

[a] Based on data from Shacklette and Boerngen 1984 for the states of Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming.

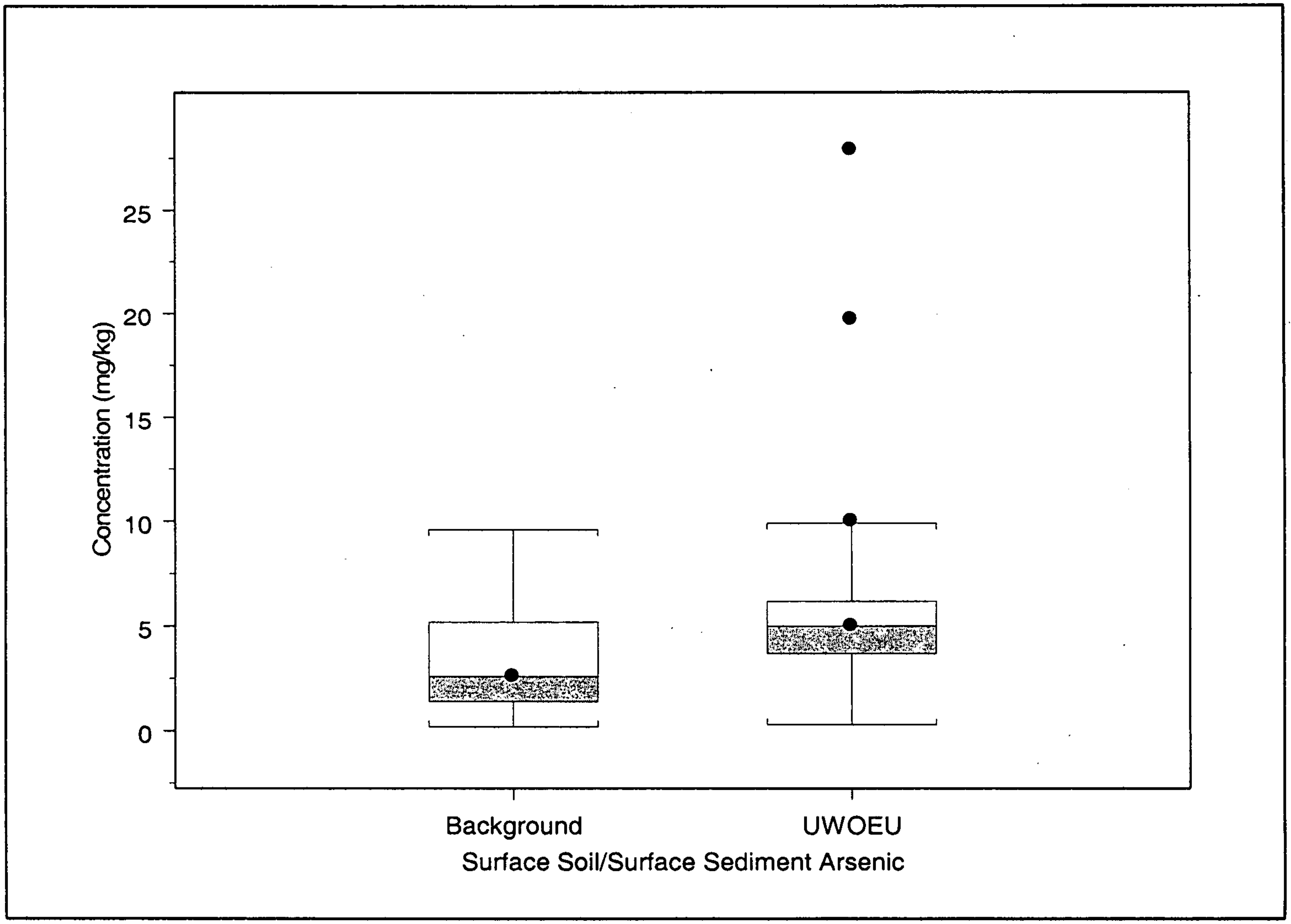
[b] One-half the detection limit used as proxy value for nondetects in computation of the mean and standard deviation.

**Figure K3.2.1**
**UWOEU Surface Soil Box Plots for Aluminum**



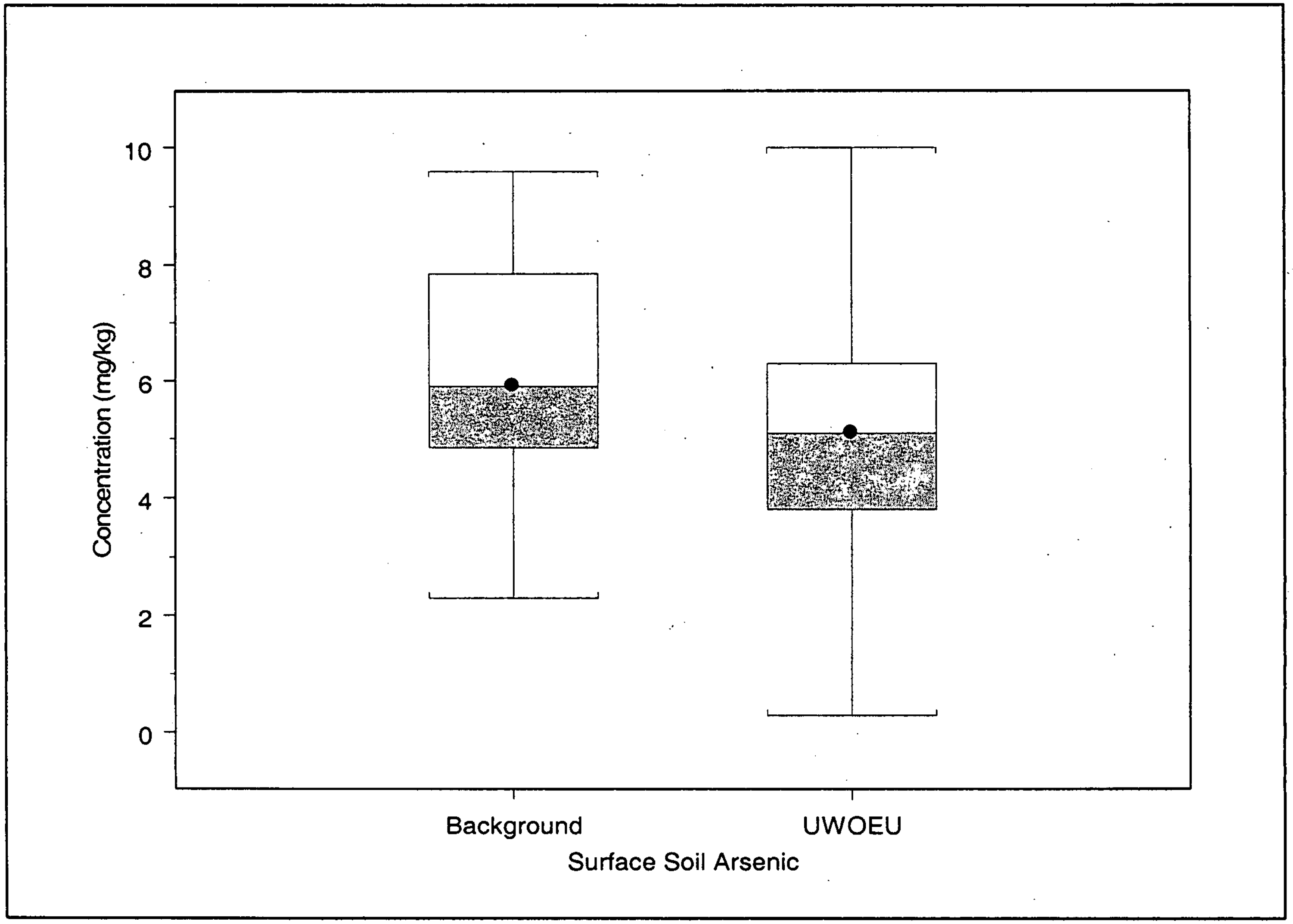

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible]3.2.2**
**UWOEU Surface Soil/Surface Sediment Box Plots for Arsenic**



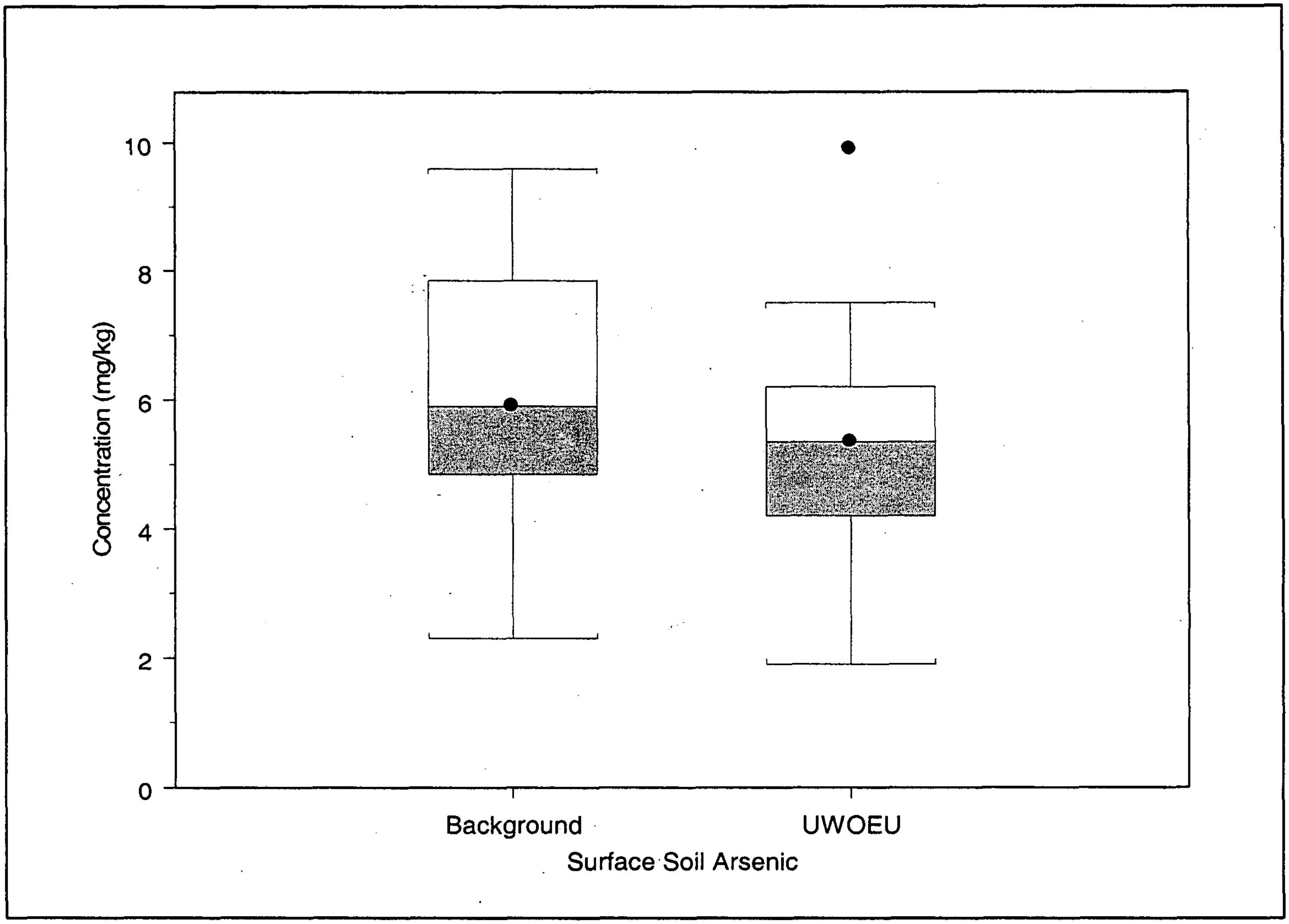

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure A3.2.3**
**UWOEU Surface Soil Box Plots for Arsenic**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

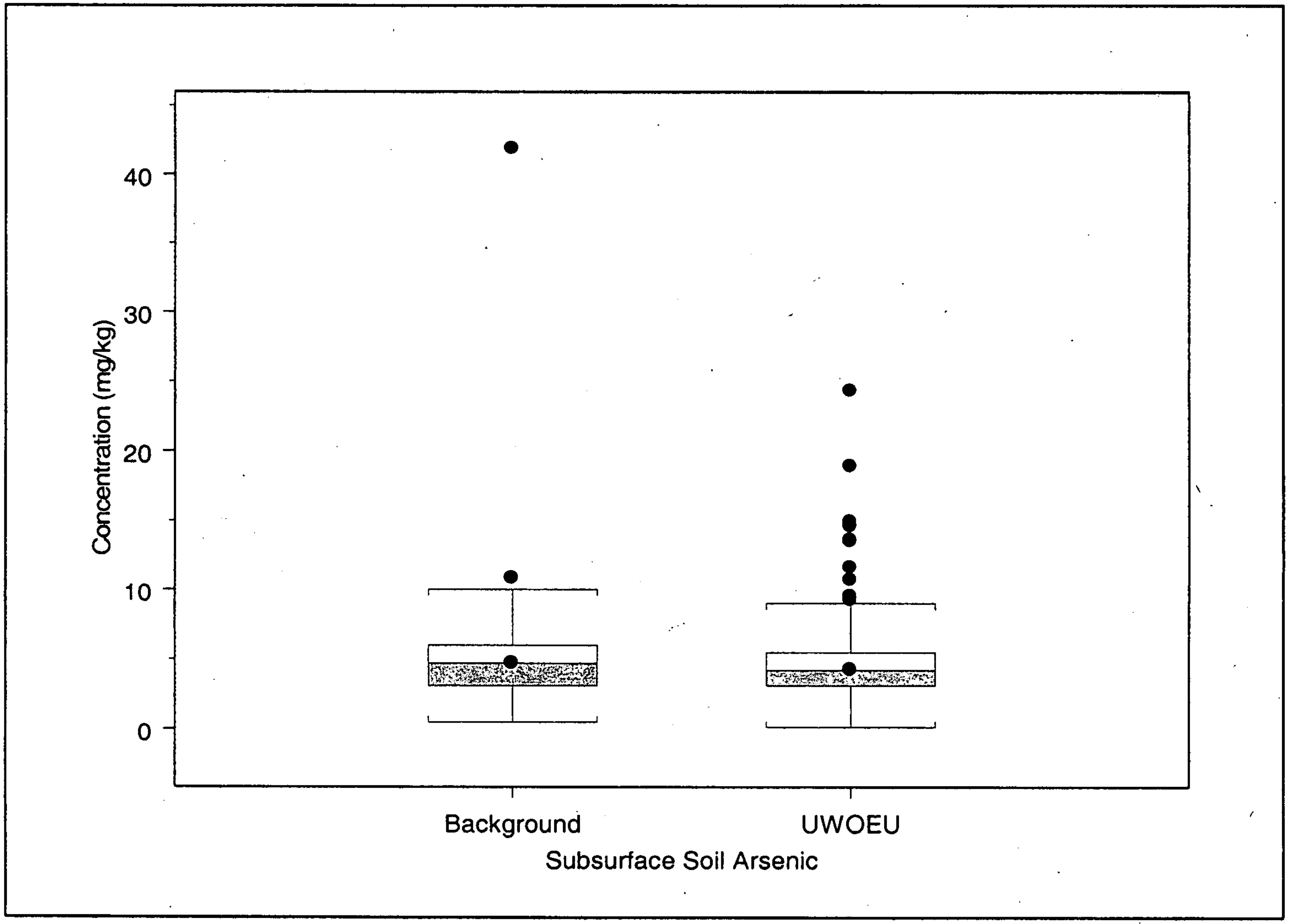
**Figure A3.2.4**
**UWOEU Surface Soil (PMJM) Box Plots for Arsenic**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

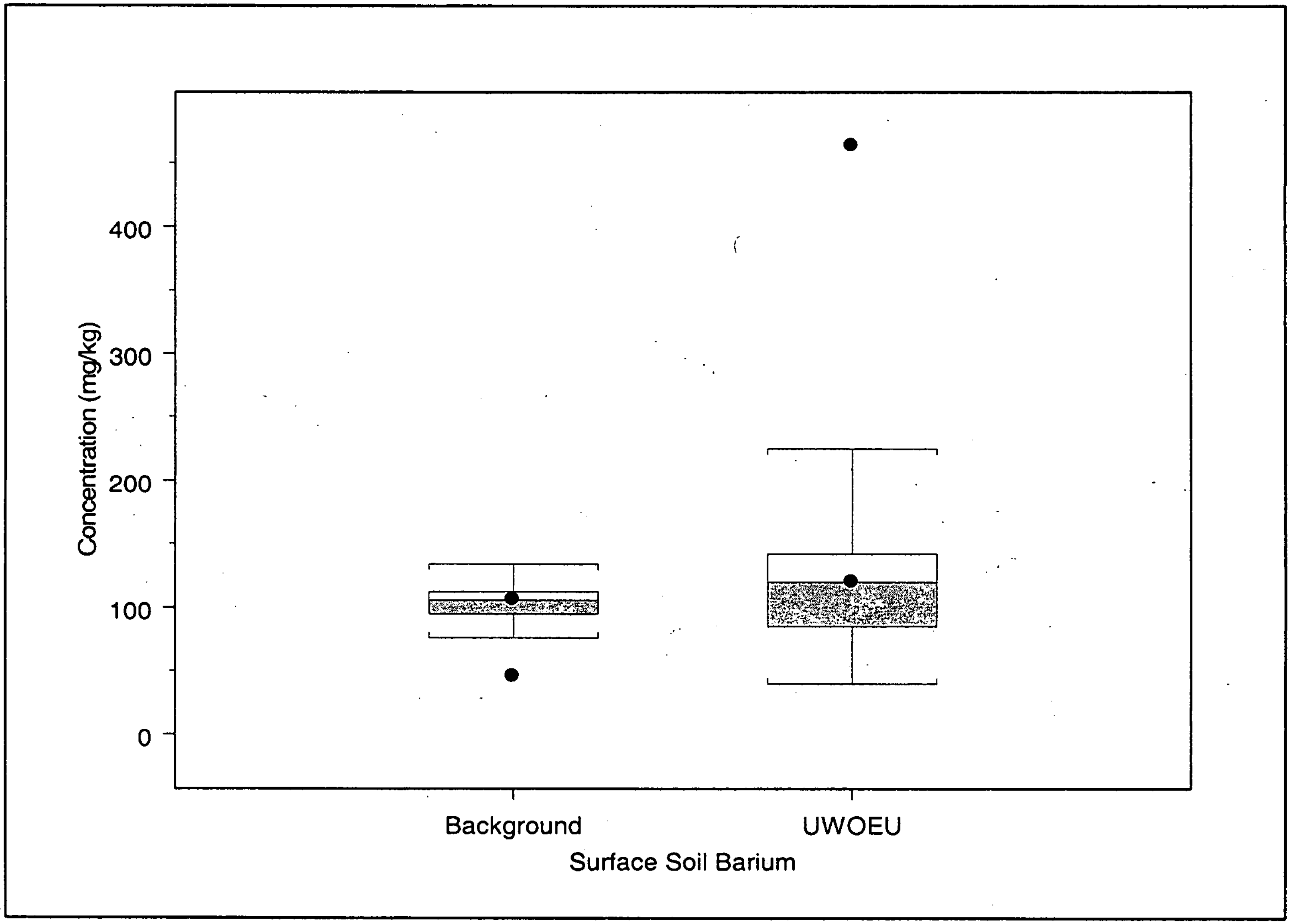
**Figu[illegible]3.2.5**

**UWOEU Subsurface Soil Box Plots for Arsenic**



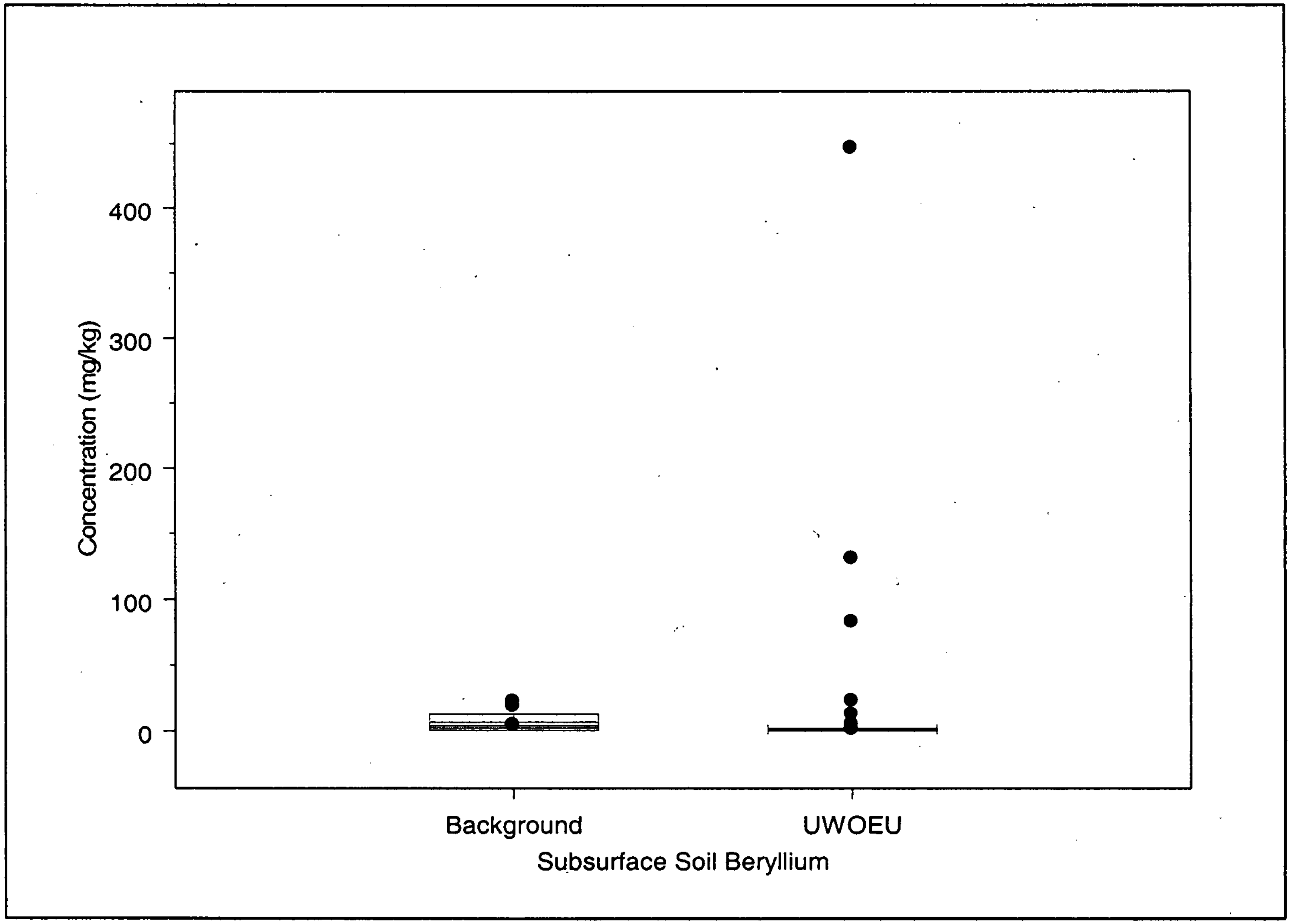

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible]3.2.6**
**UWOEU Surface Soil Box Plots for Barium**



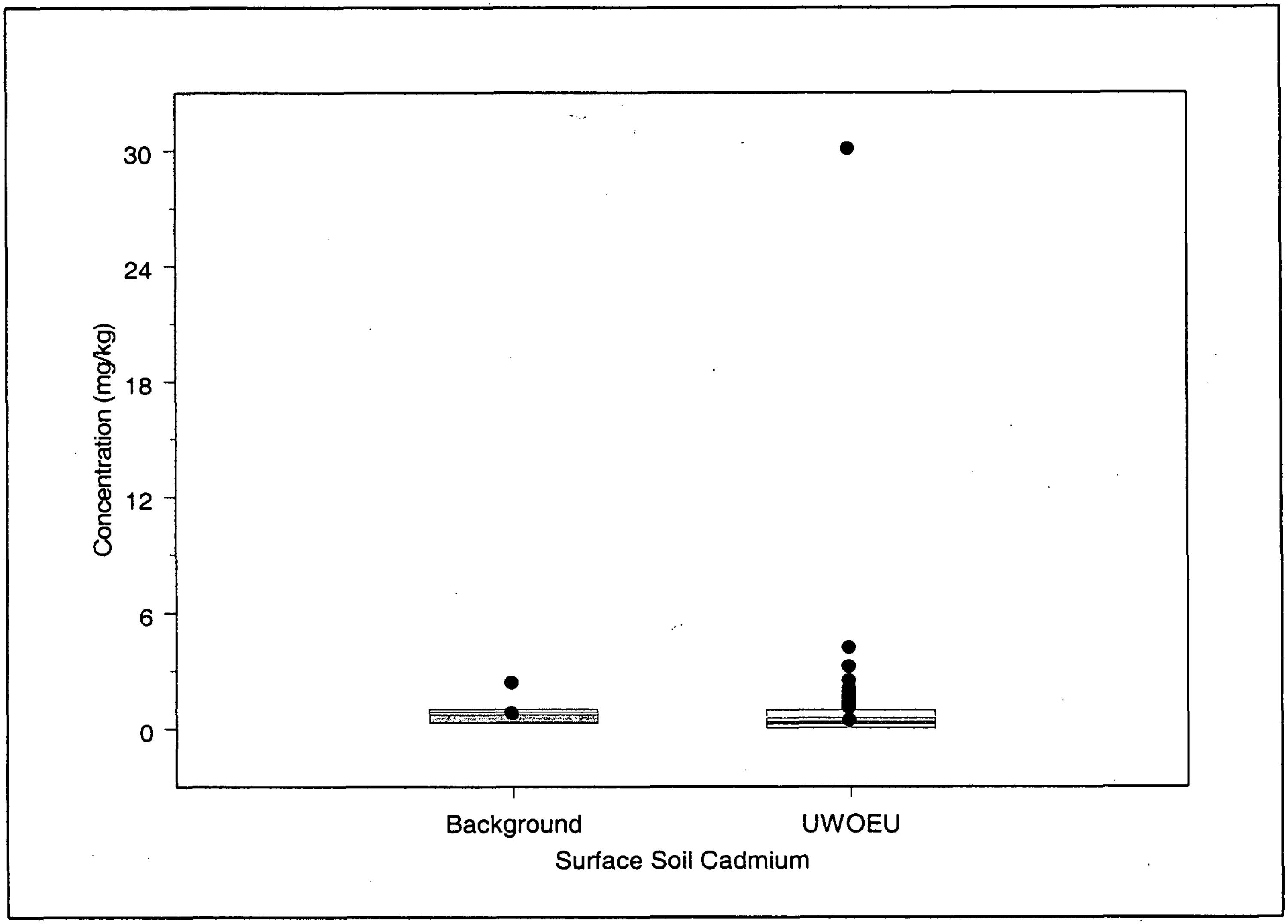

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu 3.2.7**
**UWOEU Subsurface Soil Box Plots for Beryllium**



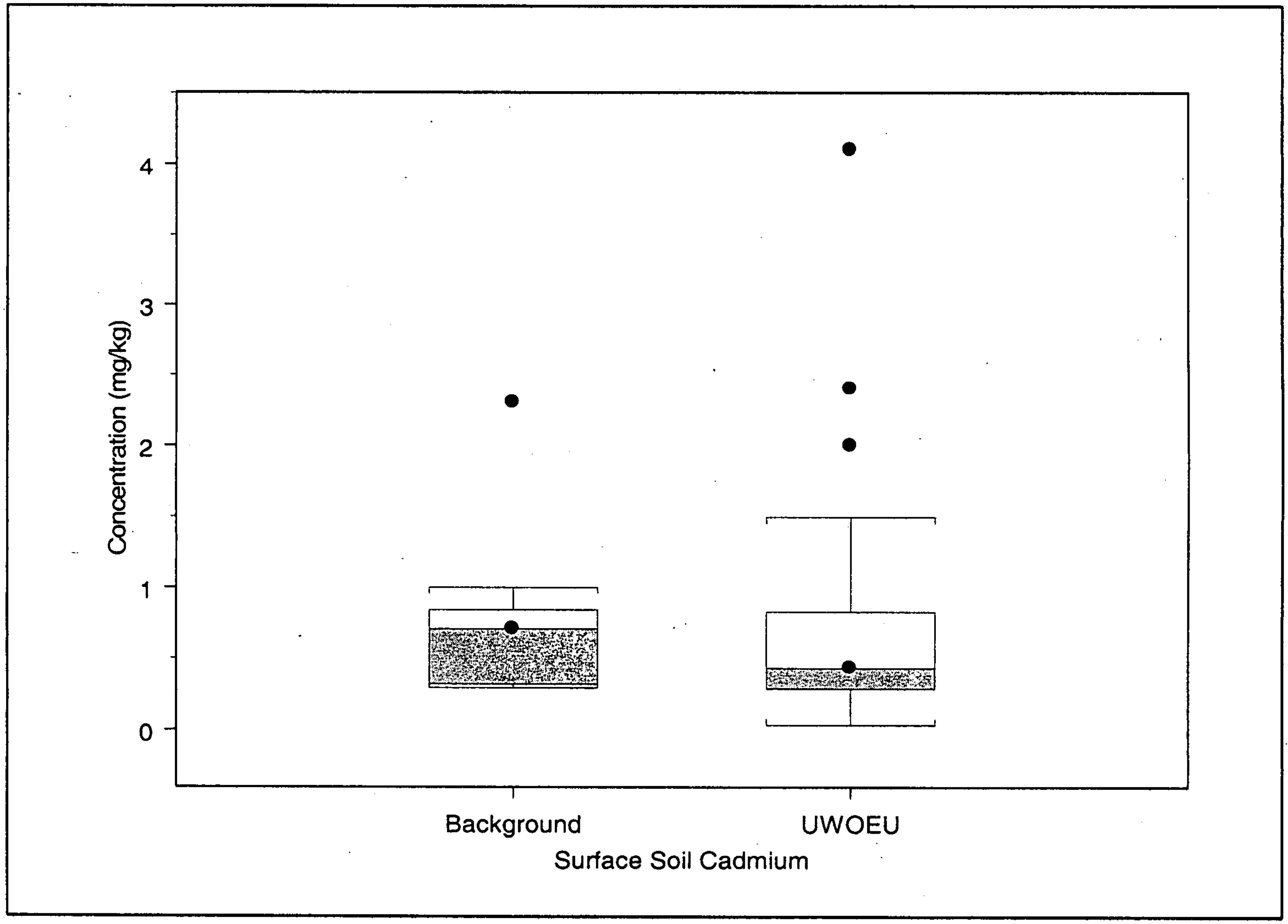

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible]3.2.8**
**UWOEU Surface Soil Box Plots for Cadmium**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

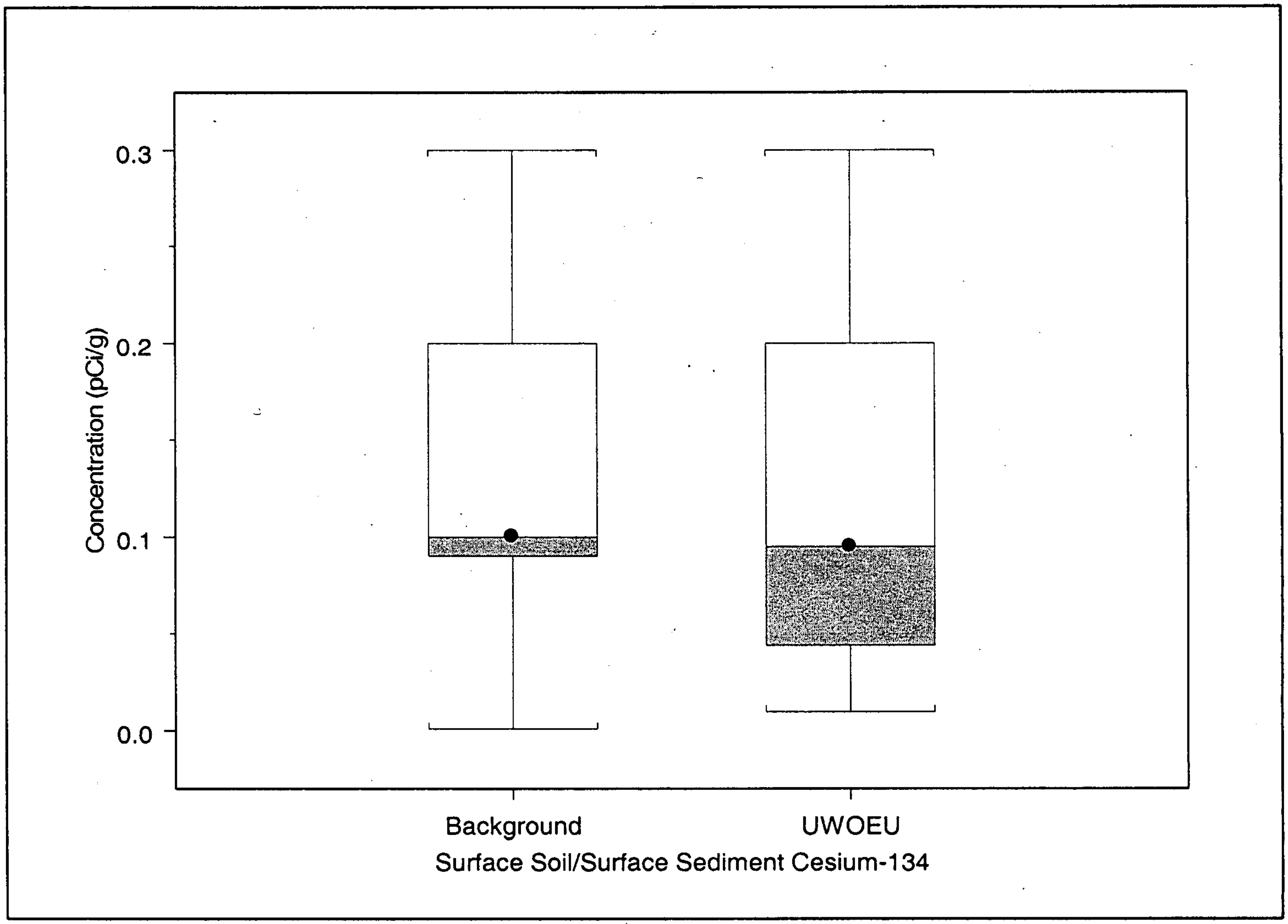
**Figure 3.2.9**
**UWOEU Surface Soil (PMJM) Box Plots for Cadmium**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

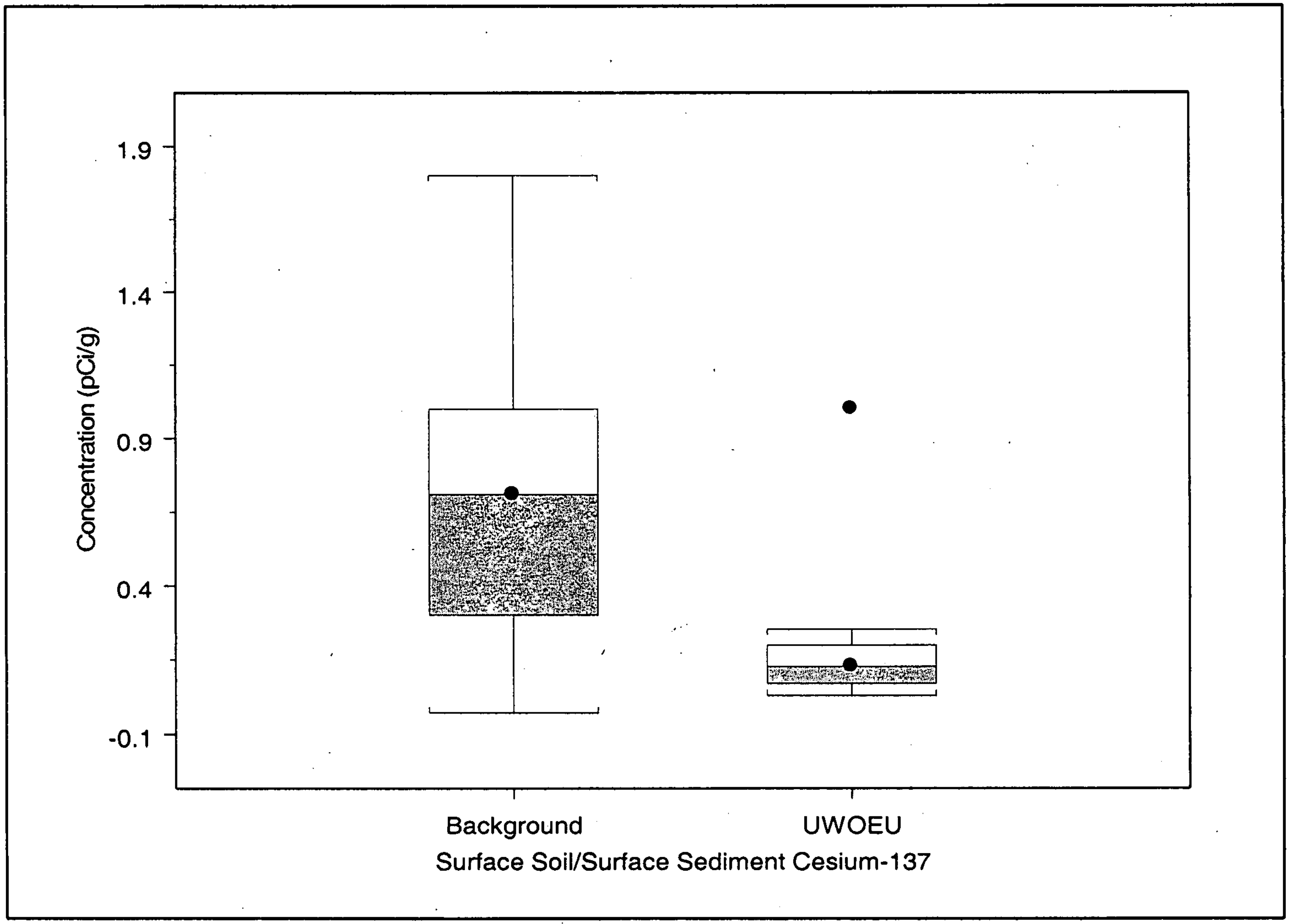
**Figure [illegible].2.10**

**UWOEU Surface Soil/Surface Sediment Box Plots for Cesium-134**



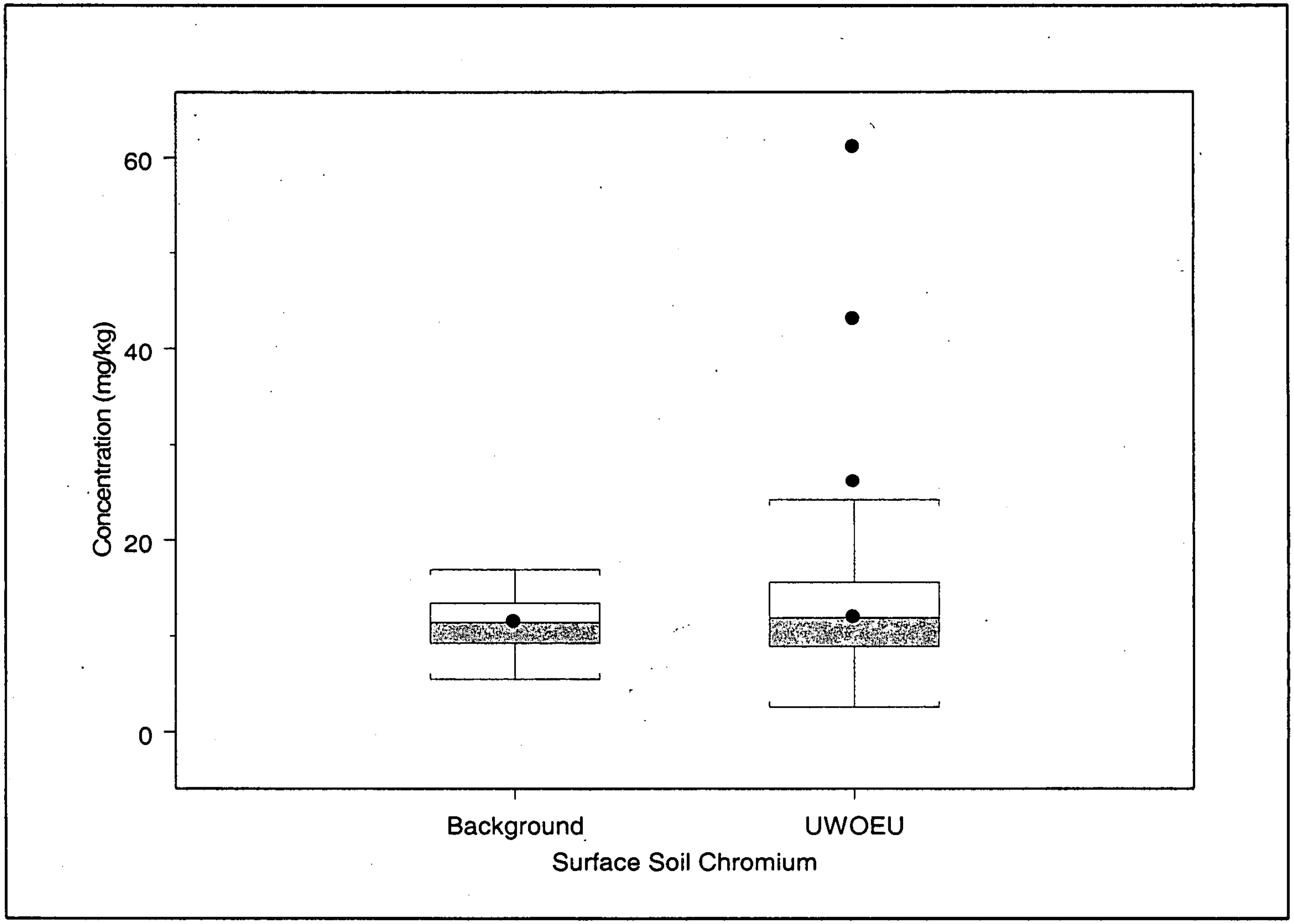

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figur[illegible].2.11**
**UWOEU Surface Soil/Surface Sediment Box Plots for Cesium-137**



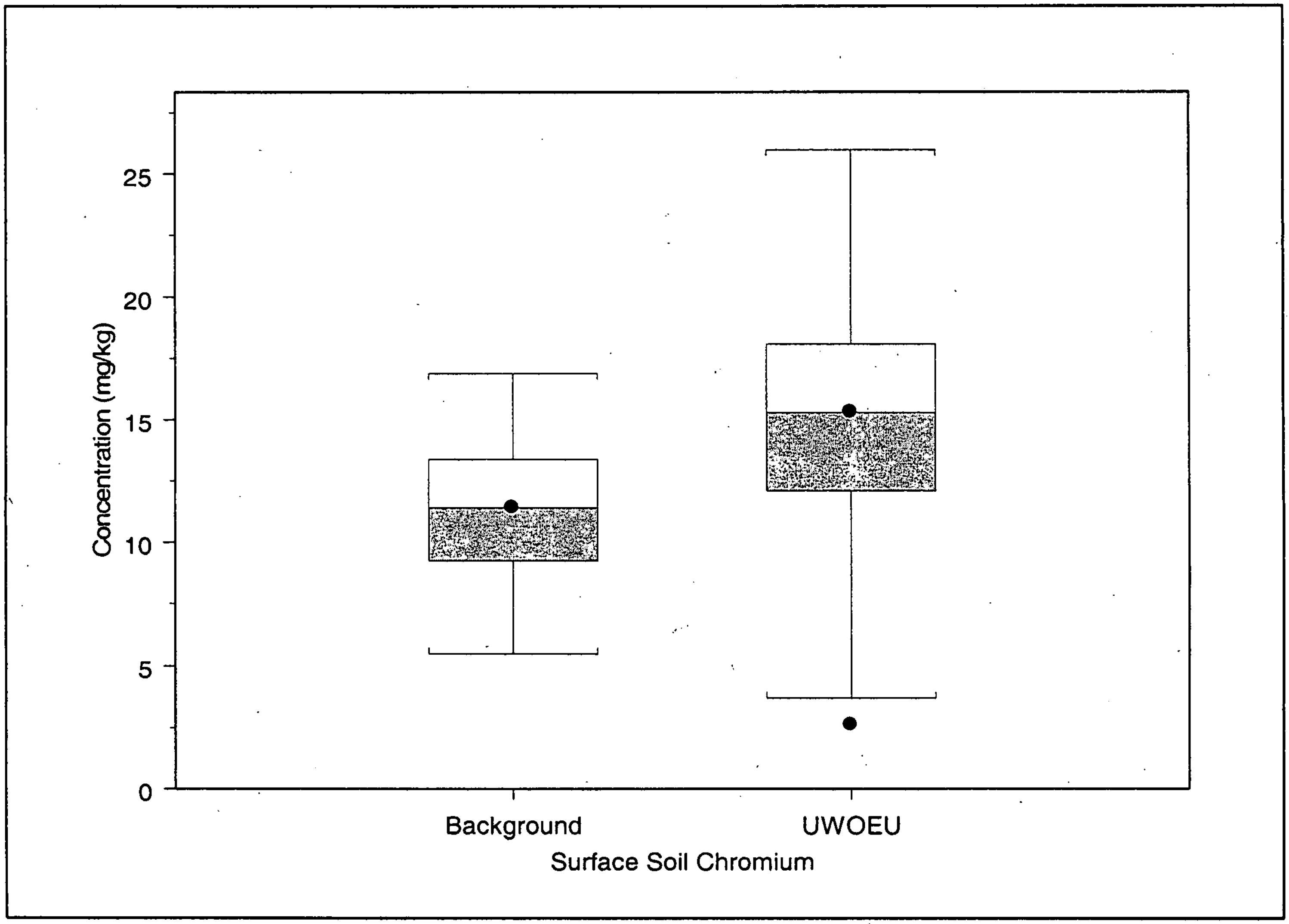

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure 3.2.12**
**UWOEU Surface Soil Box Plots for Chromium**



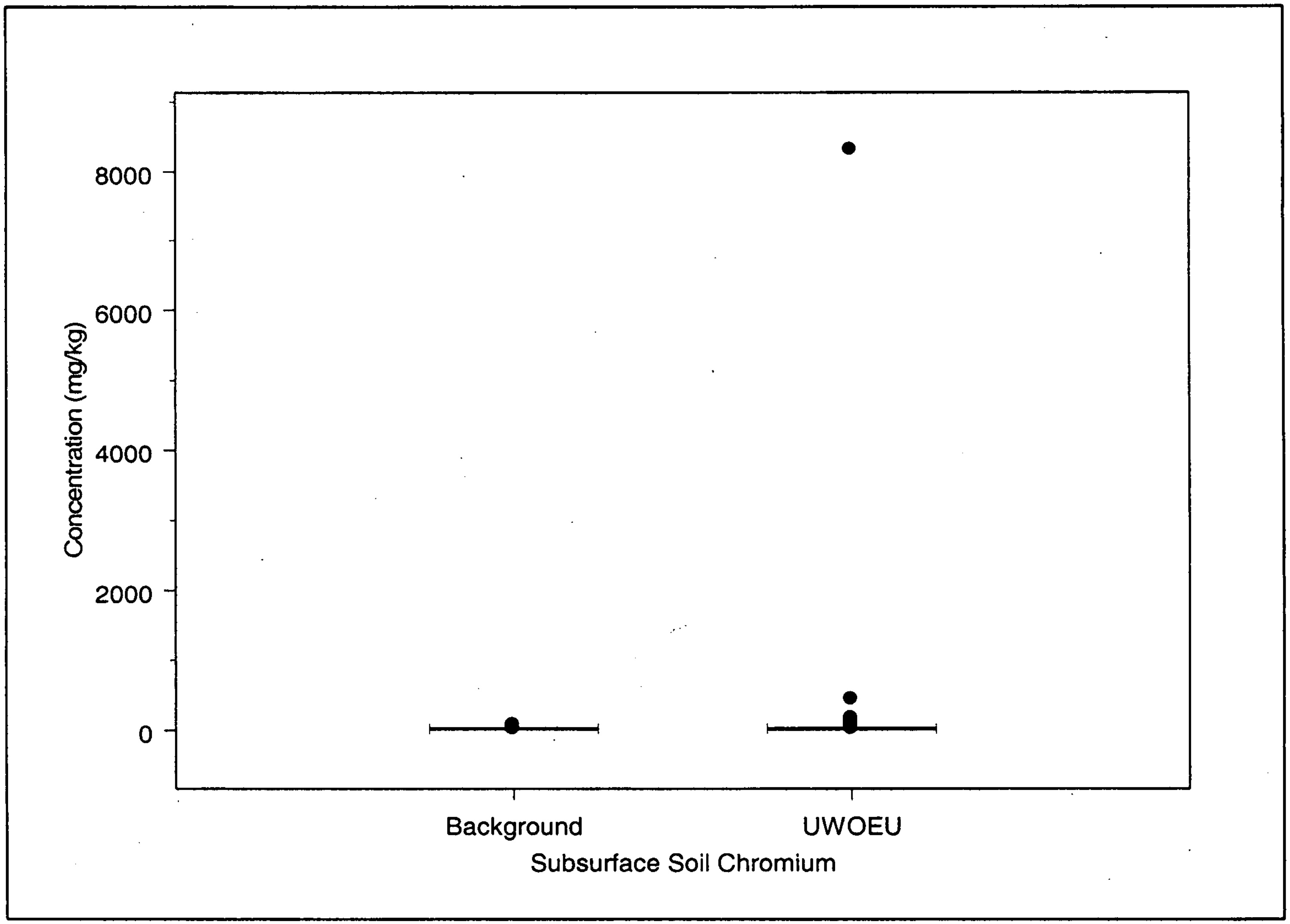

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure [illegible].2.13**
**UWOEU Surface Soil (PMJM) Box Plots for Chromium**



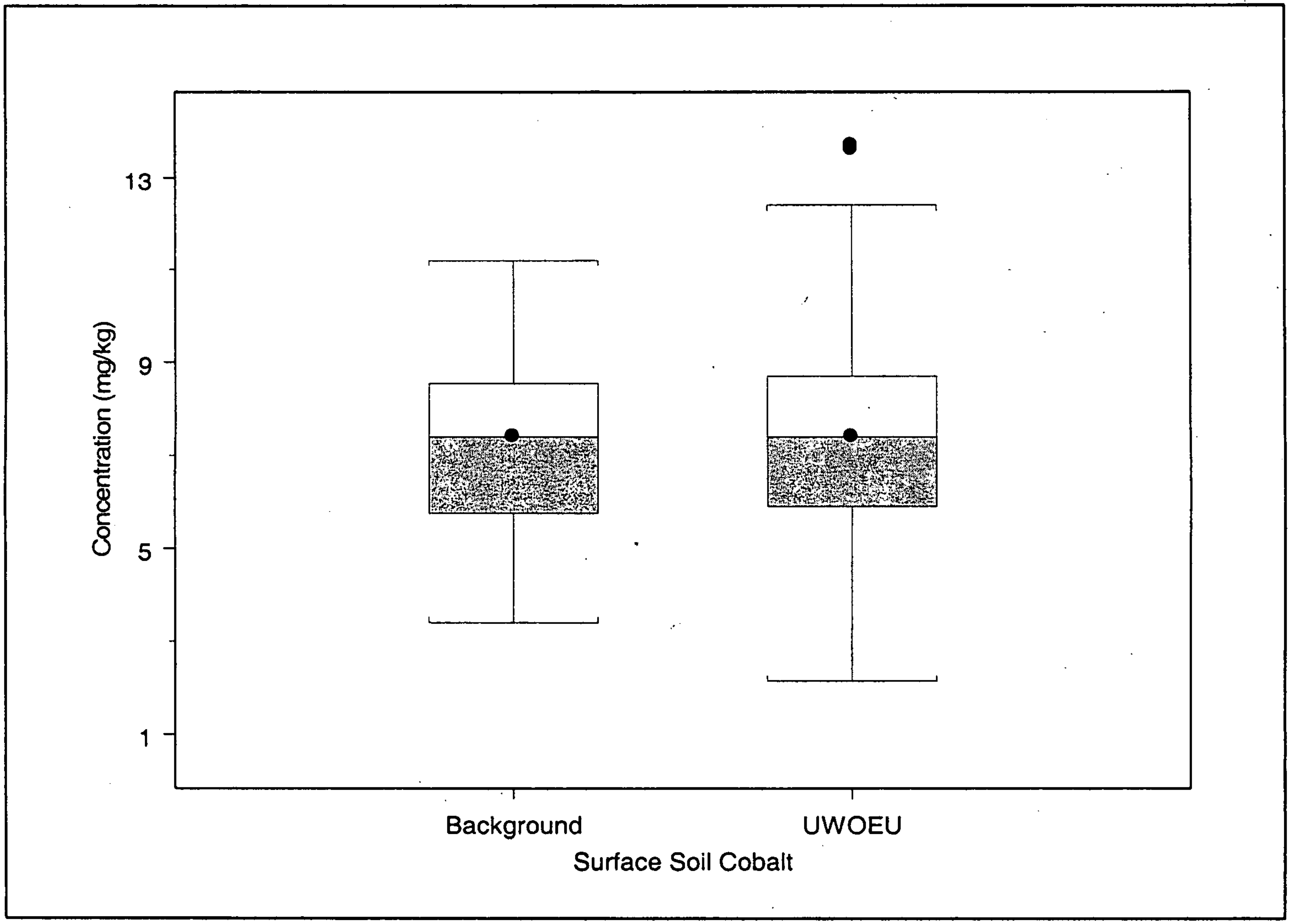

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure 3.2.14**
**UWOEU Subsurface Soil Box Plots for Chromium**



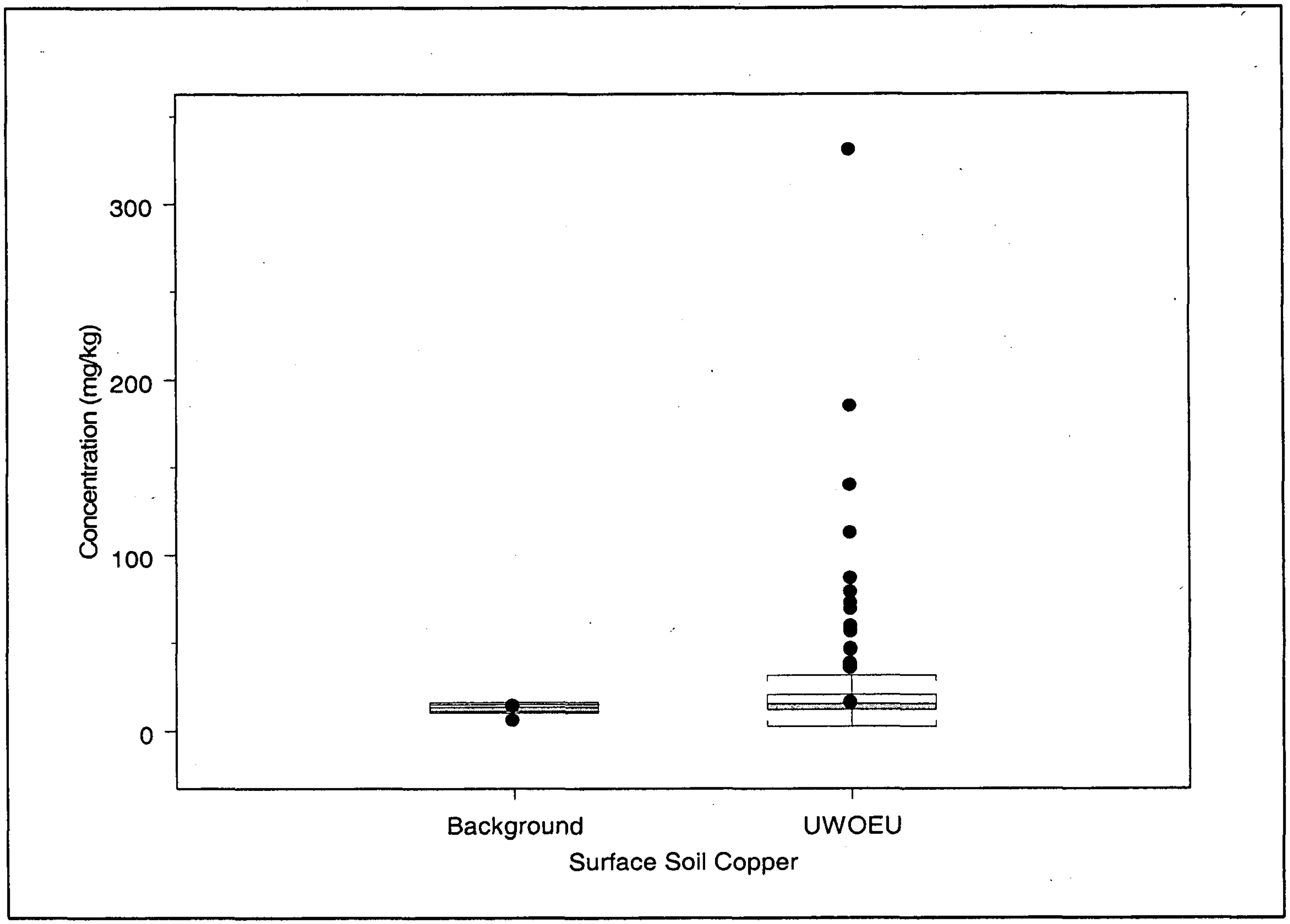

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure A3.2.15**
**UWOEU Surface Soil Box Plots for Cobalt**



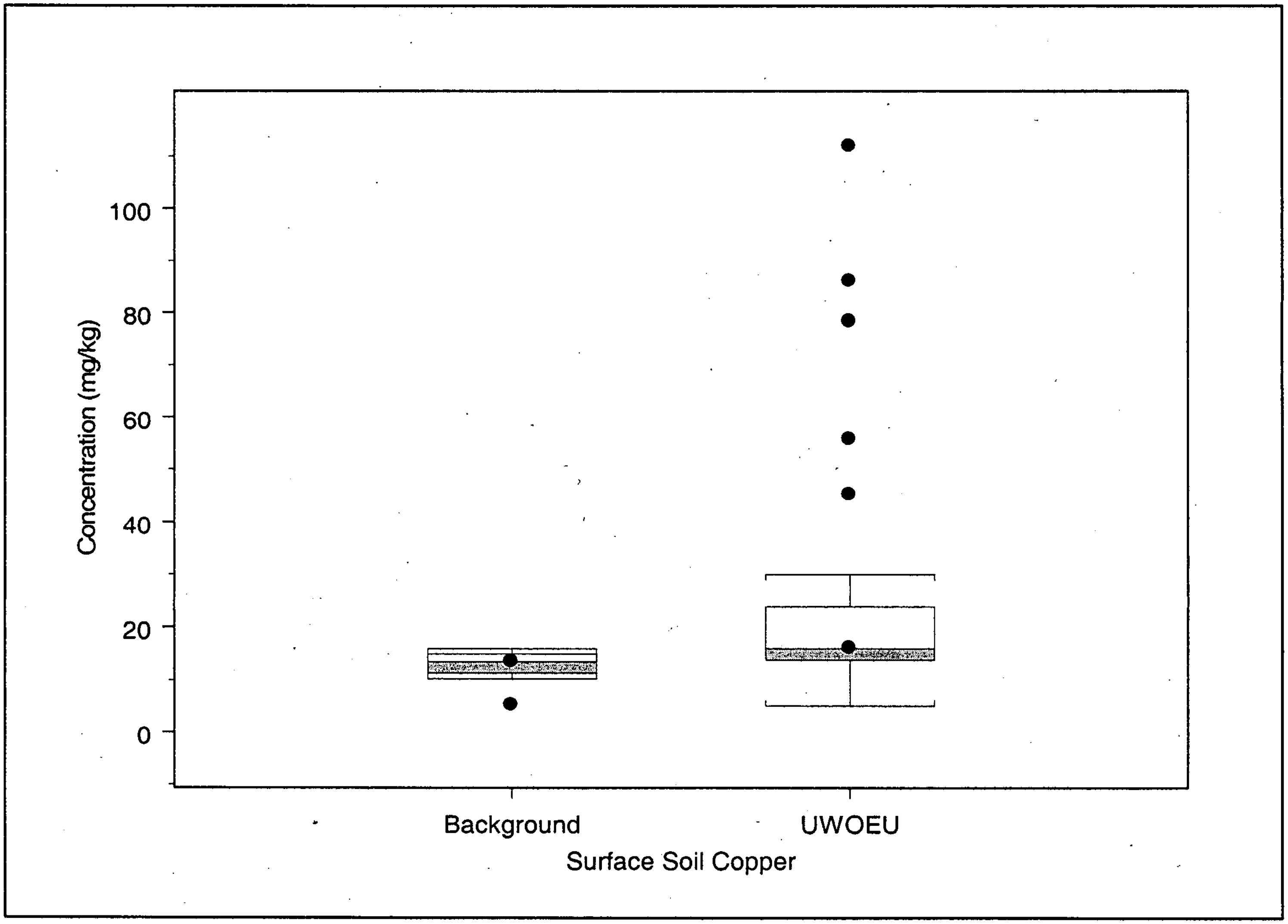

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure 3.2.16**
**UWOEU Surface Soil Box Plots for Copper**



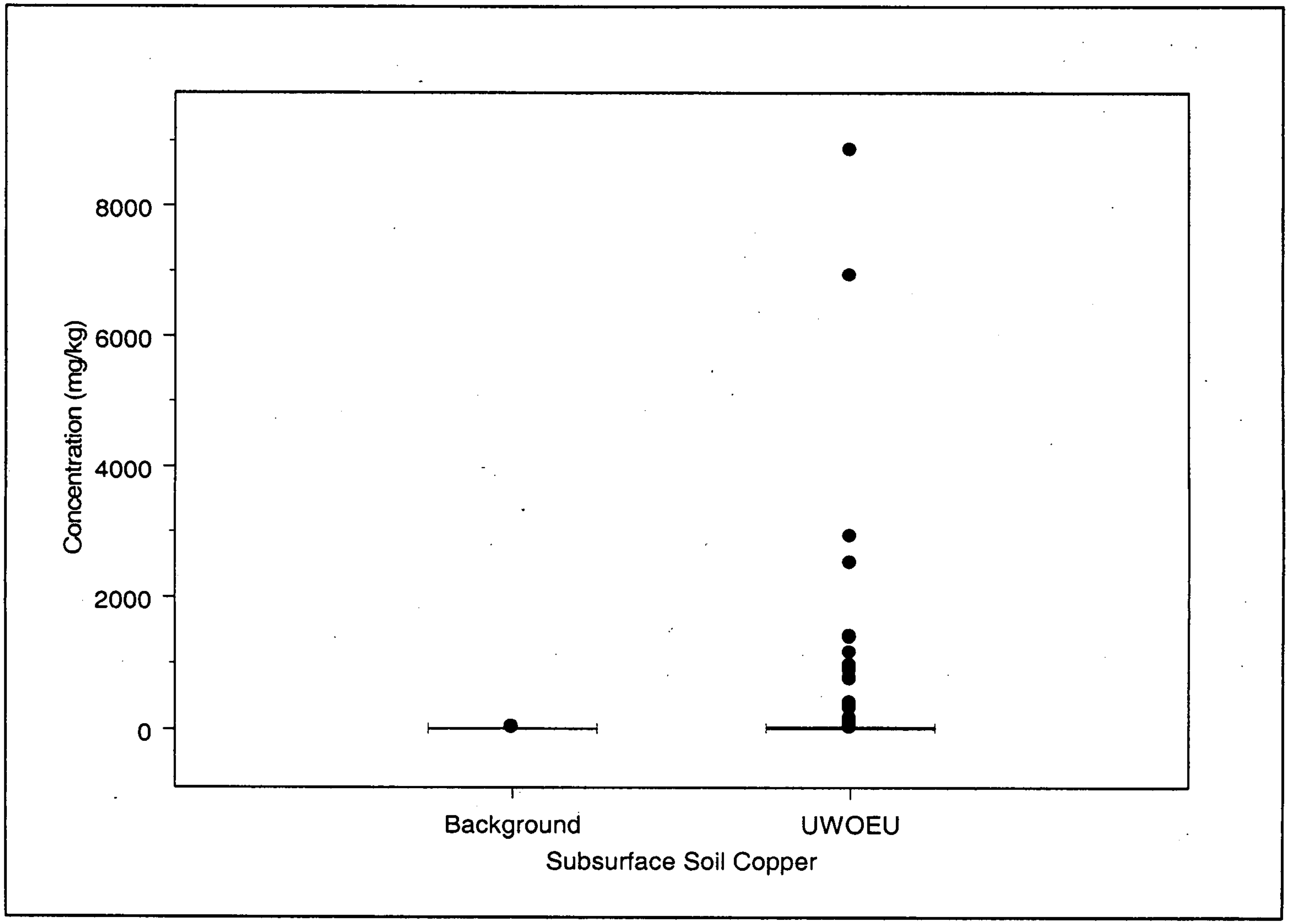

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible].2.17**
**UWOEU Surface Soil (PMJM) Box Plots for Copper**



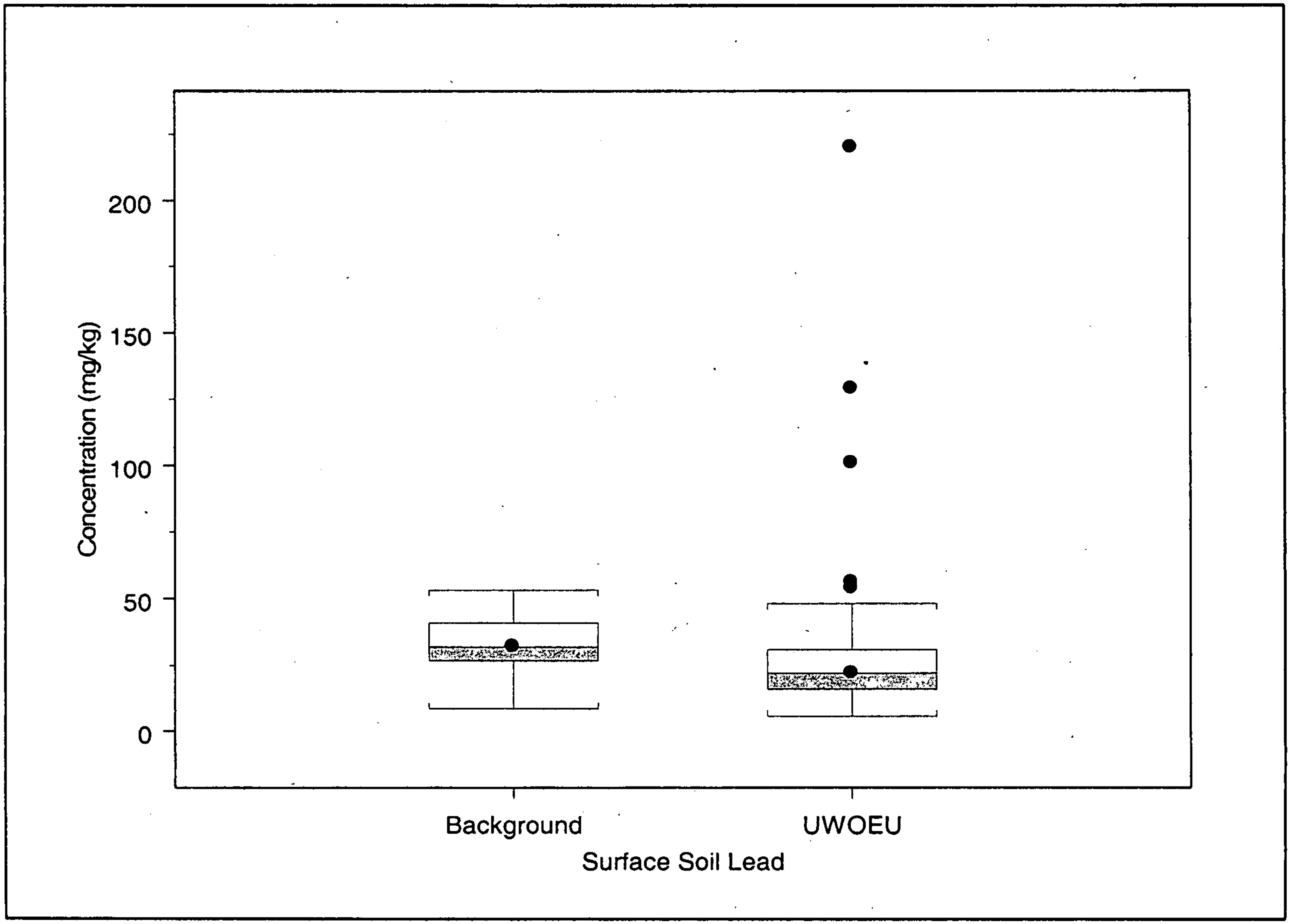

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible]3.2.18**
**UWOEU Subsurface Soil Box Plots for Copper**



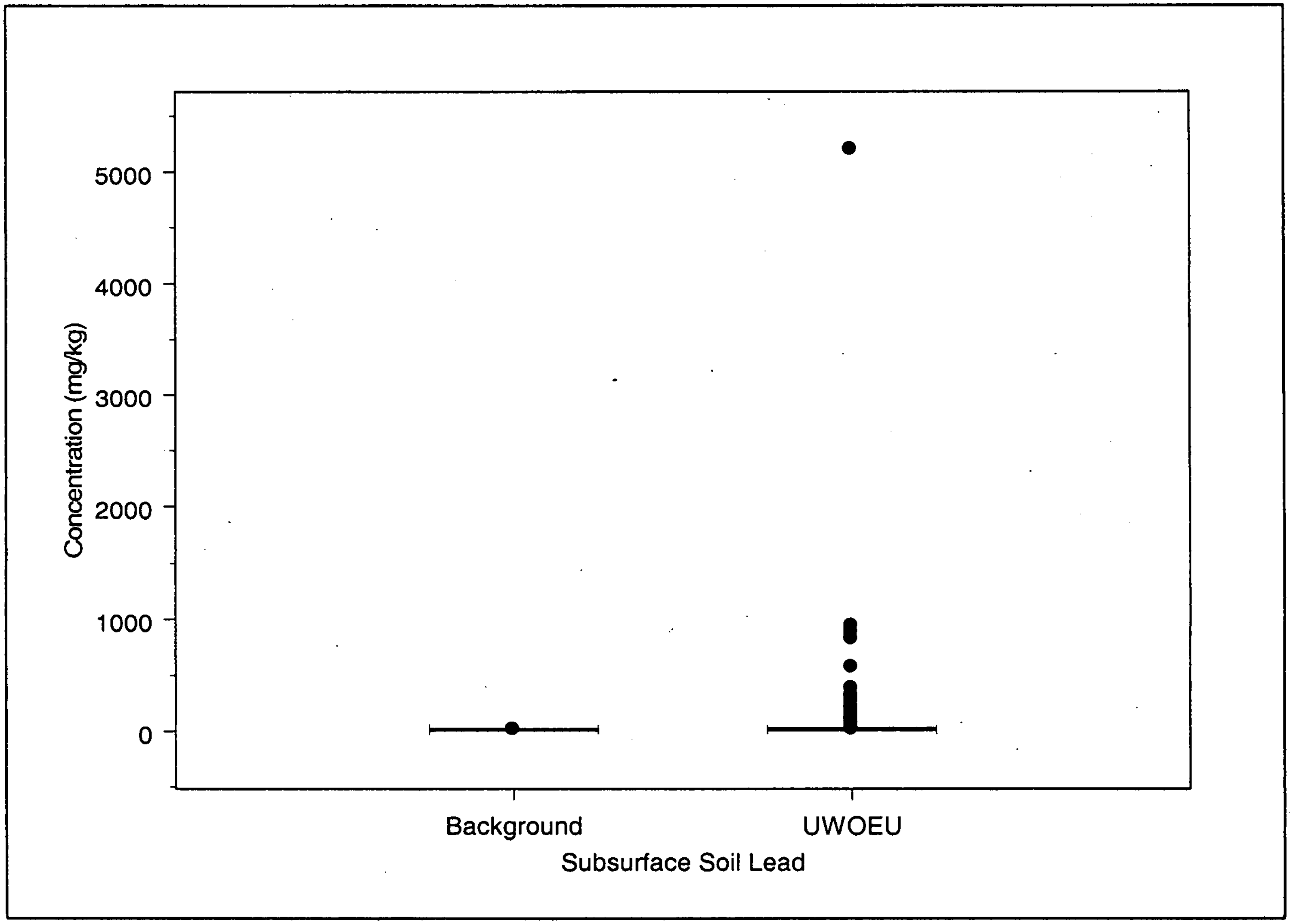

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figur[illegible].2.19**
**UWOEU Surface Soil Box Plots for Lead**



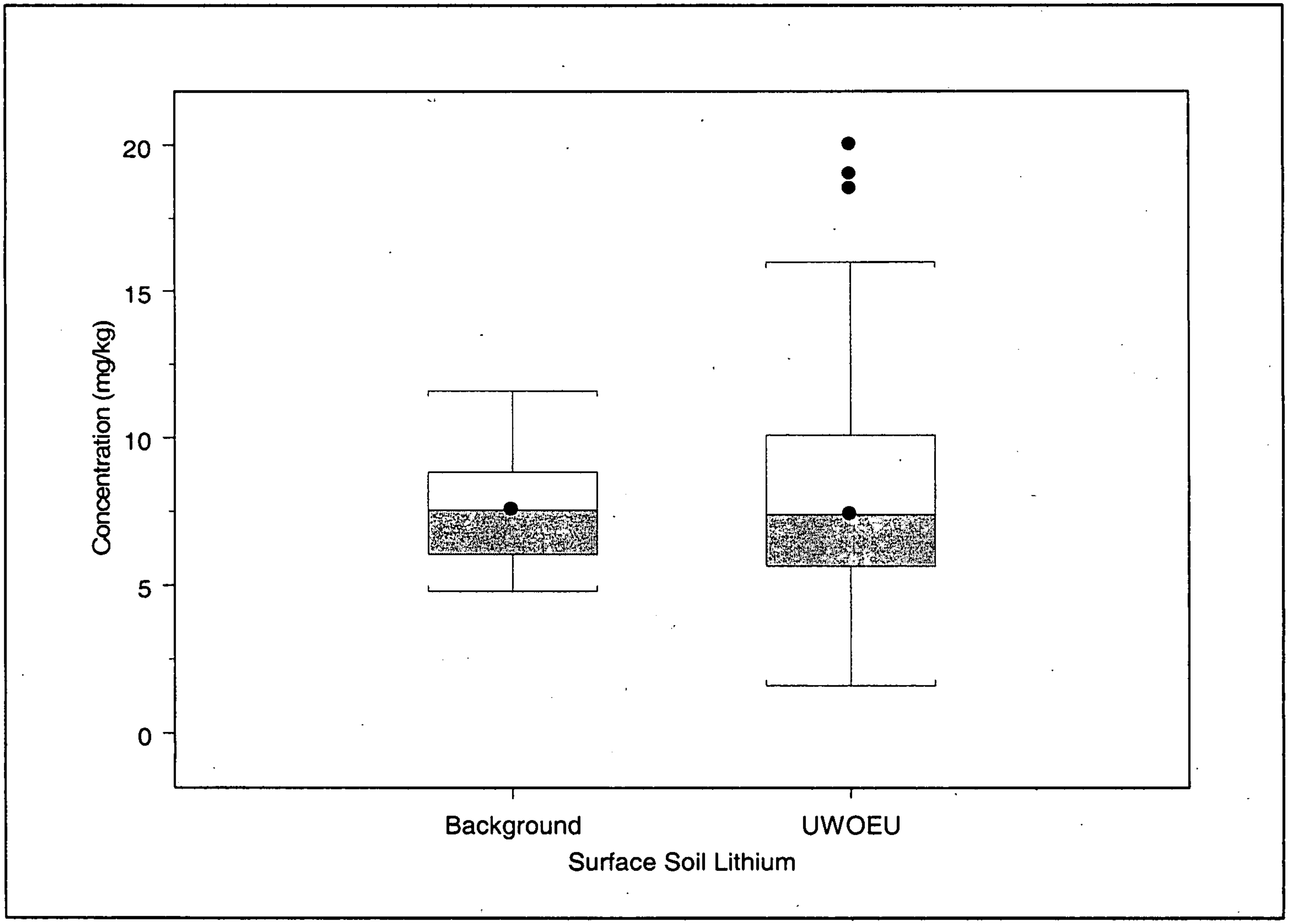

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure 3.2.20**
**UWOEU Subsurface Soil Box Plots for Lead**



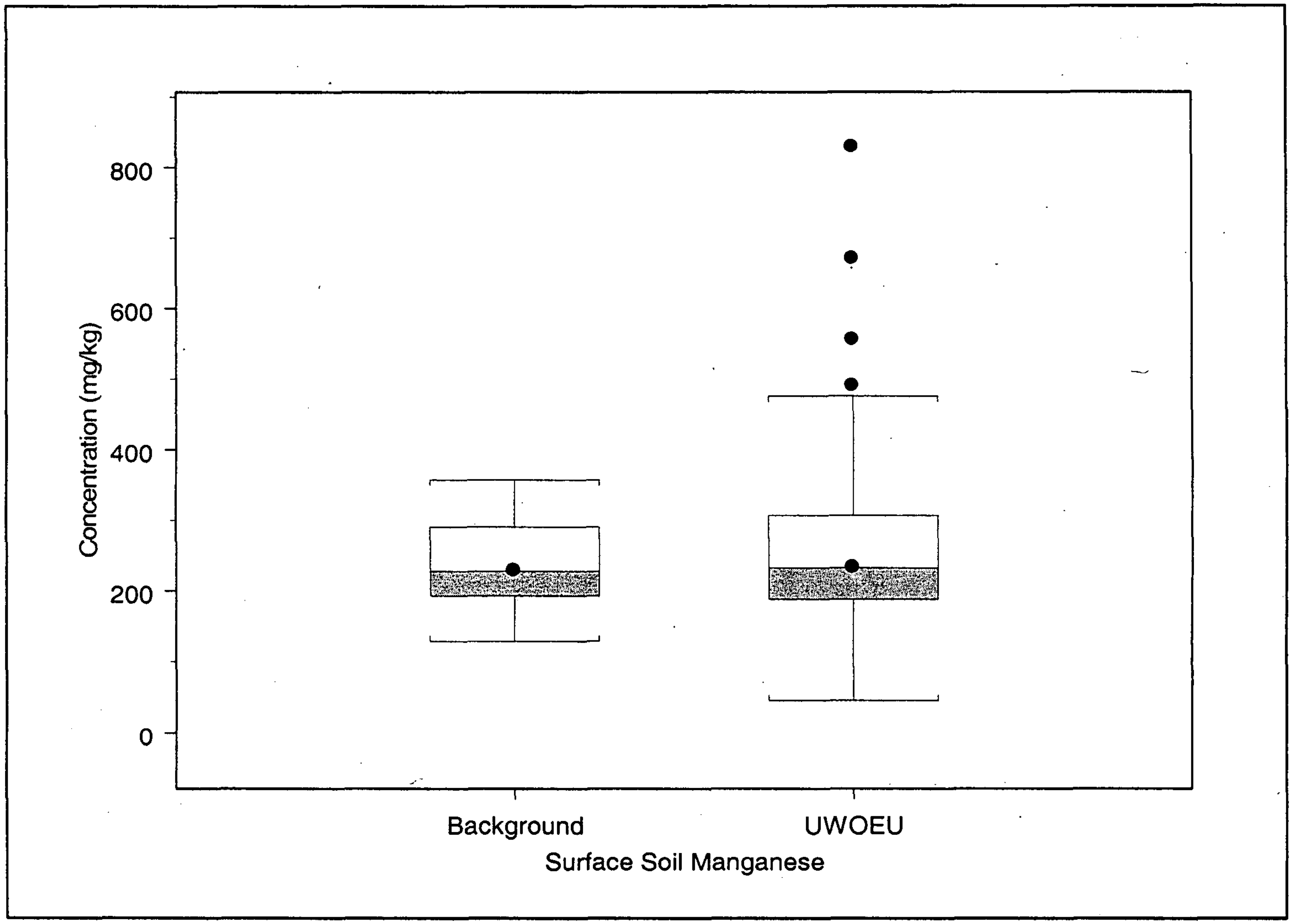

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figur[illegible].2.21**
**UWOEU Surface Soil Box Plots for Lithium**



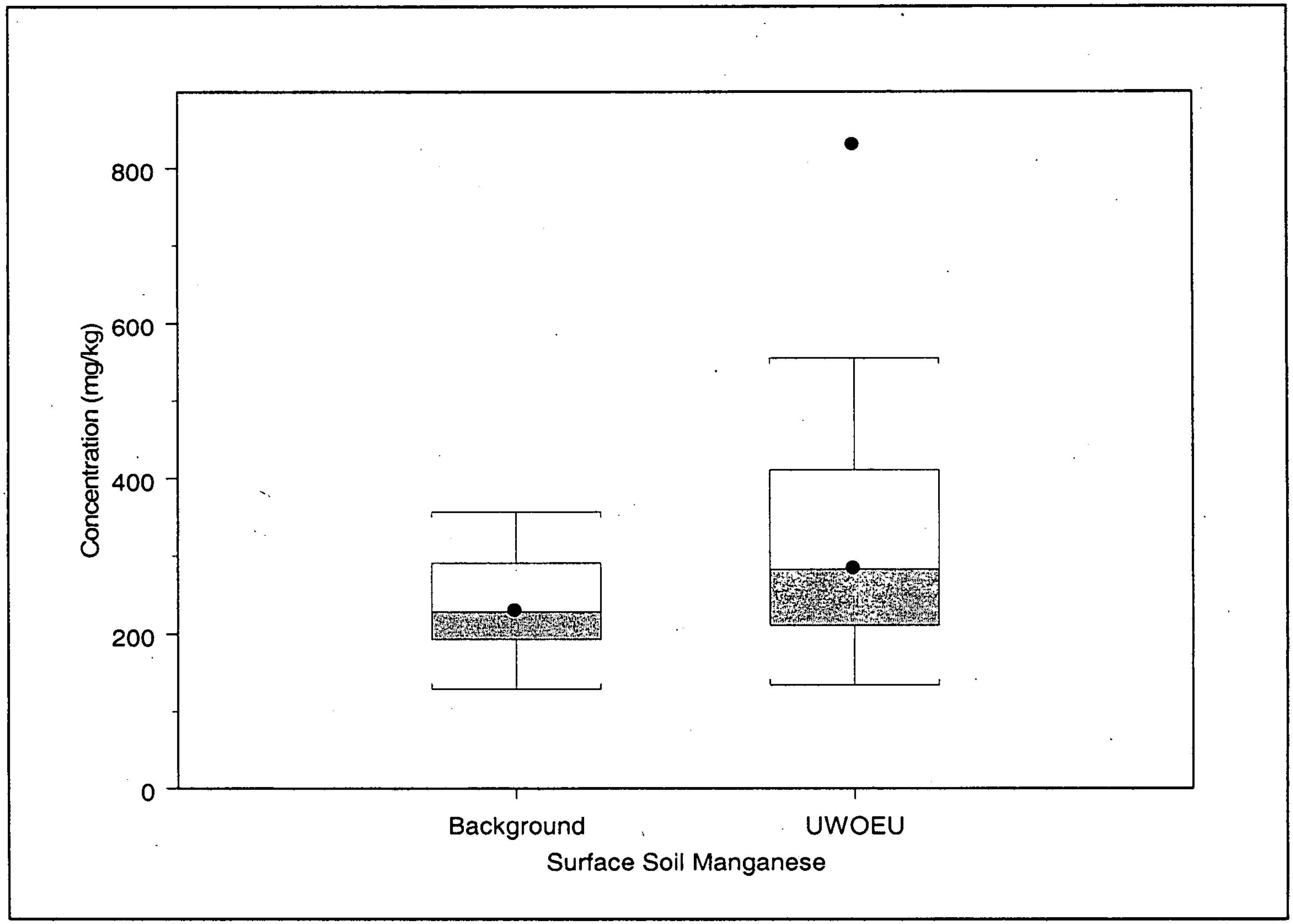

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure 3.2.22**
**UWOEU Surface Soil Box Plots for Manganese**



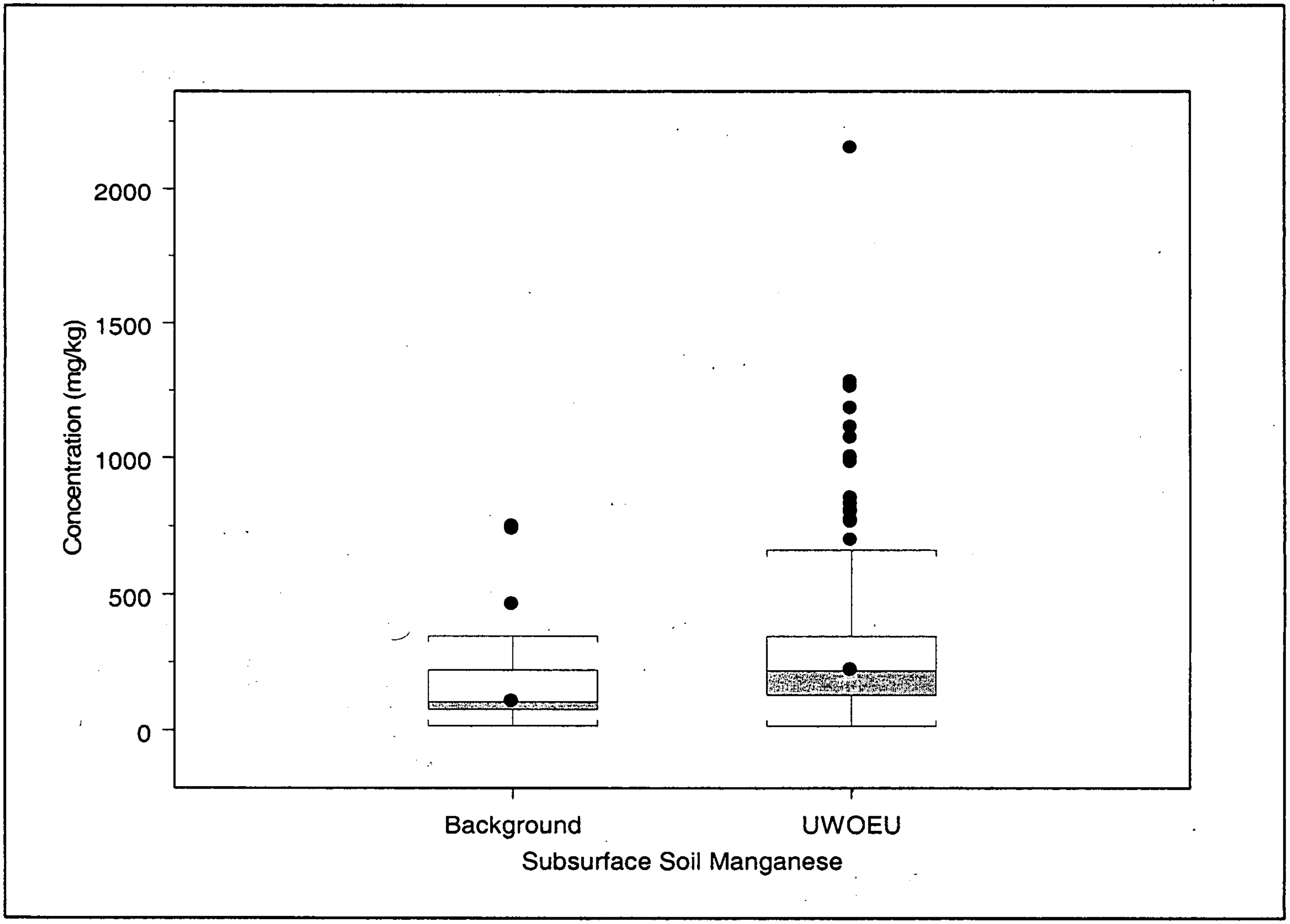

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figur[illegible]3.2.23**
**UWOEU Surface Soil (PMJM) Box Plots for Manganese**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

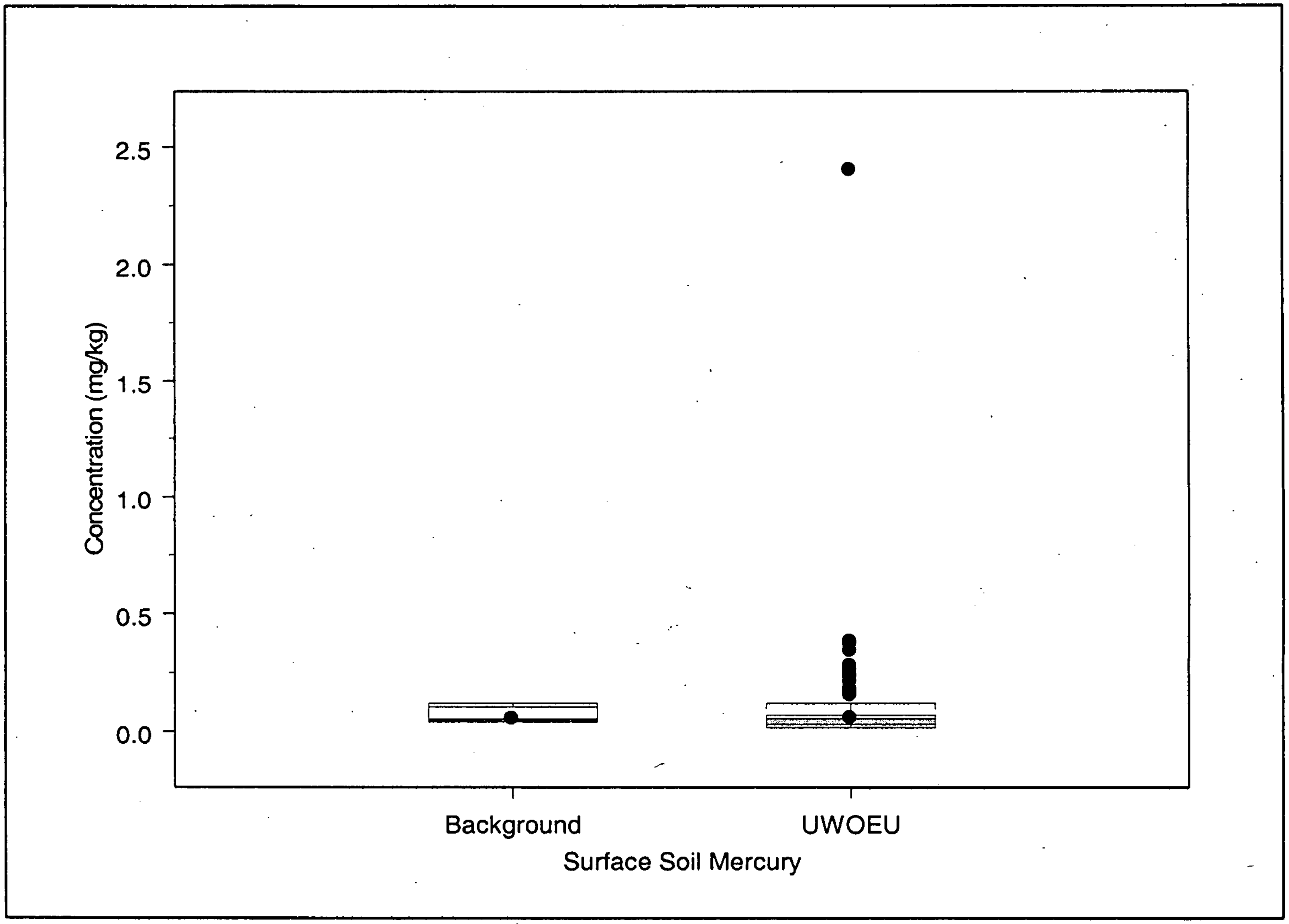
**Figure A3.2.24**
**UWOEU Subsurface Soil Box Plots for Manganese**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

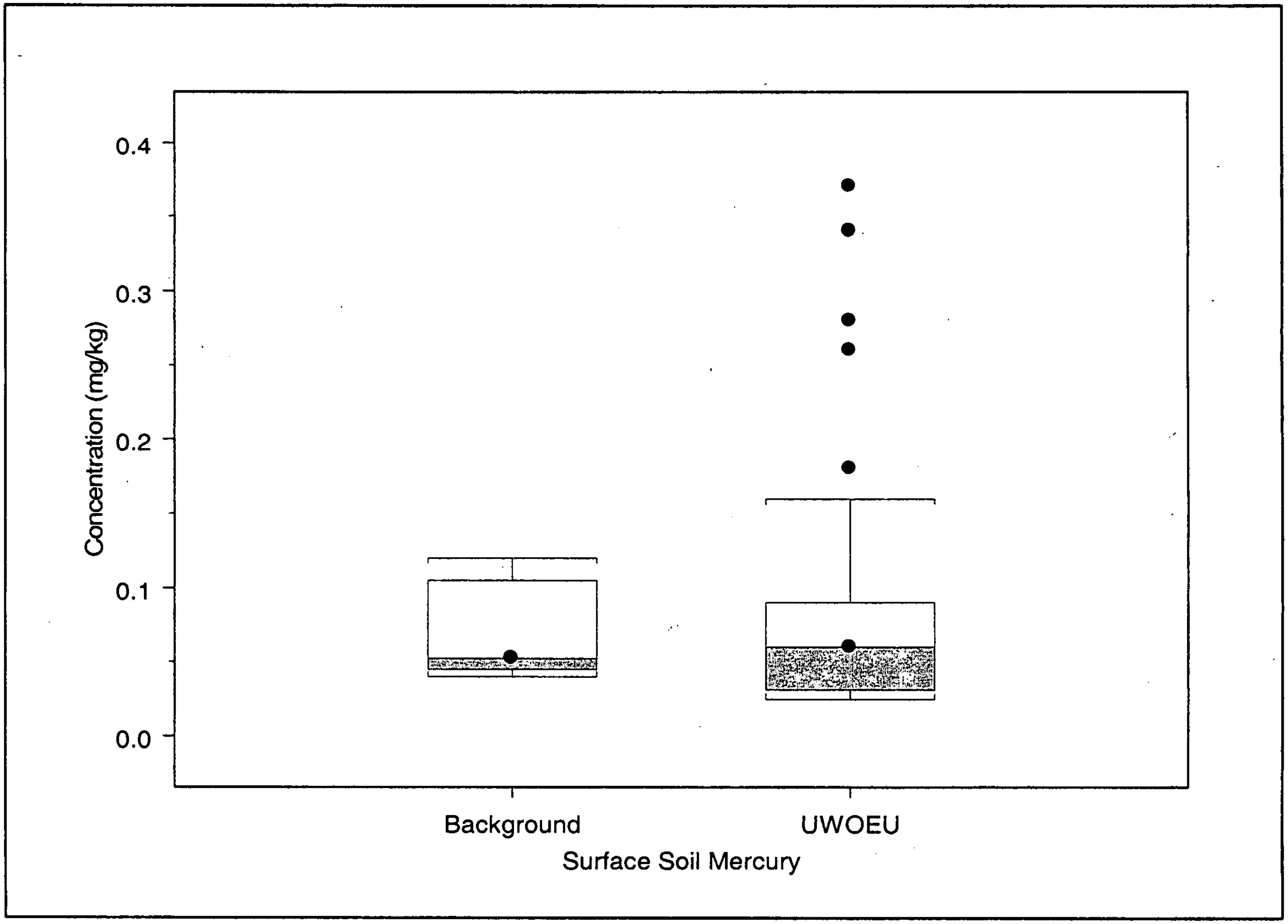
**Figu[illegible]3.2.25**

**UWOEU Surface Soil Box Plots for Mercury**



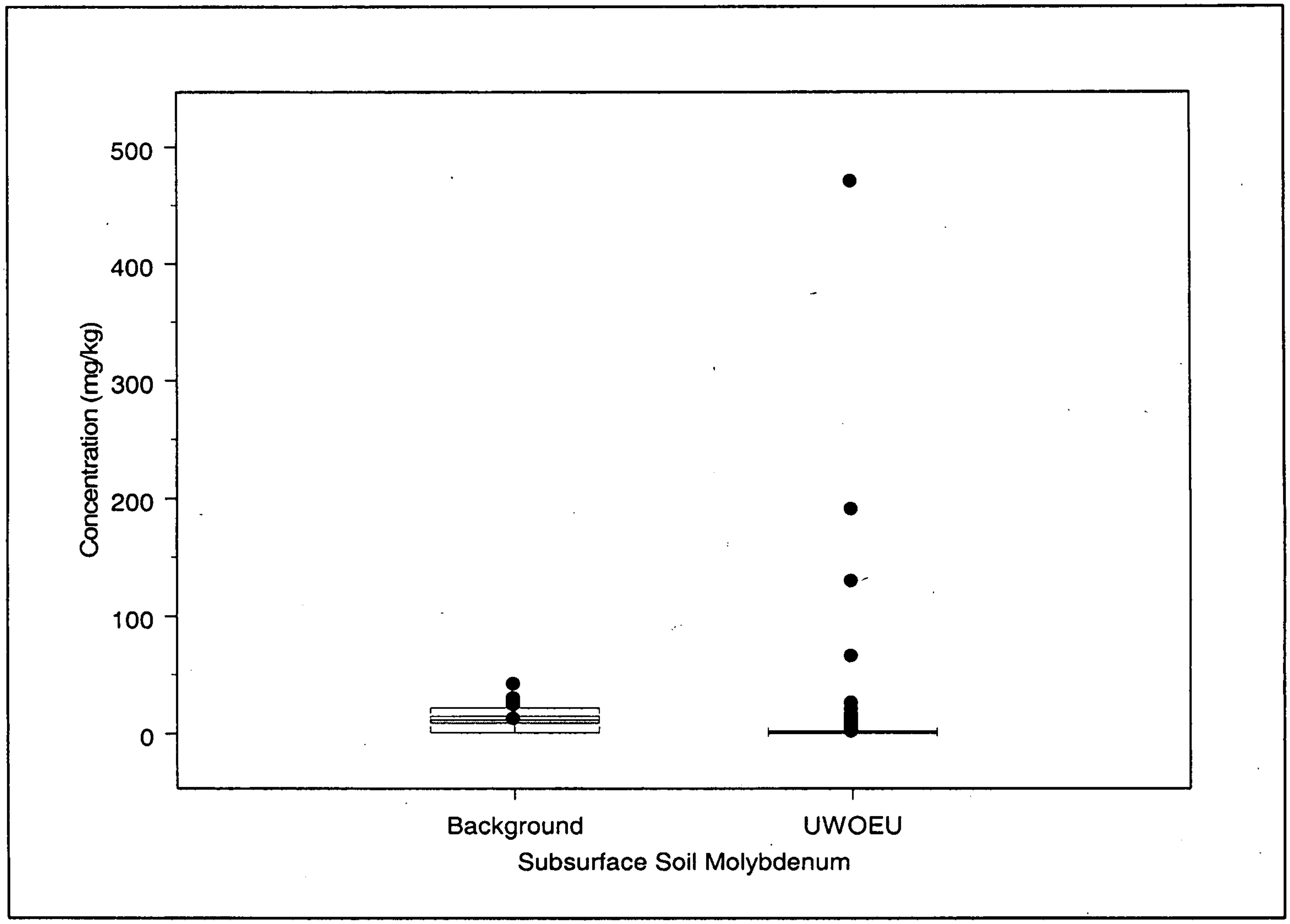

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible].2.26**
**UWOEU Surface Soil (PMJM) Box Plots for Mercury**



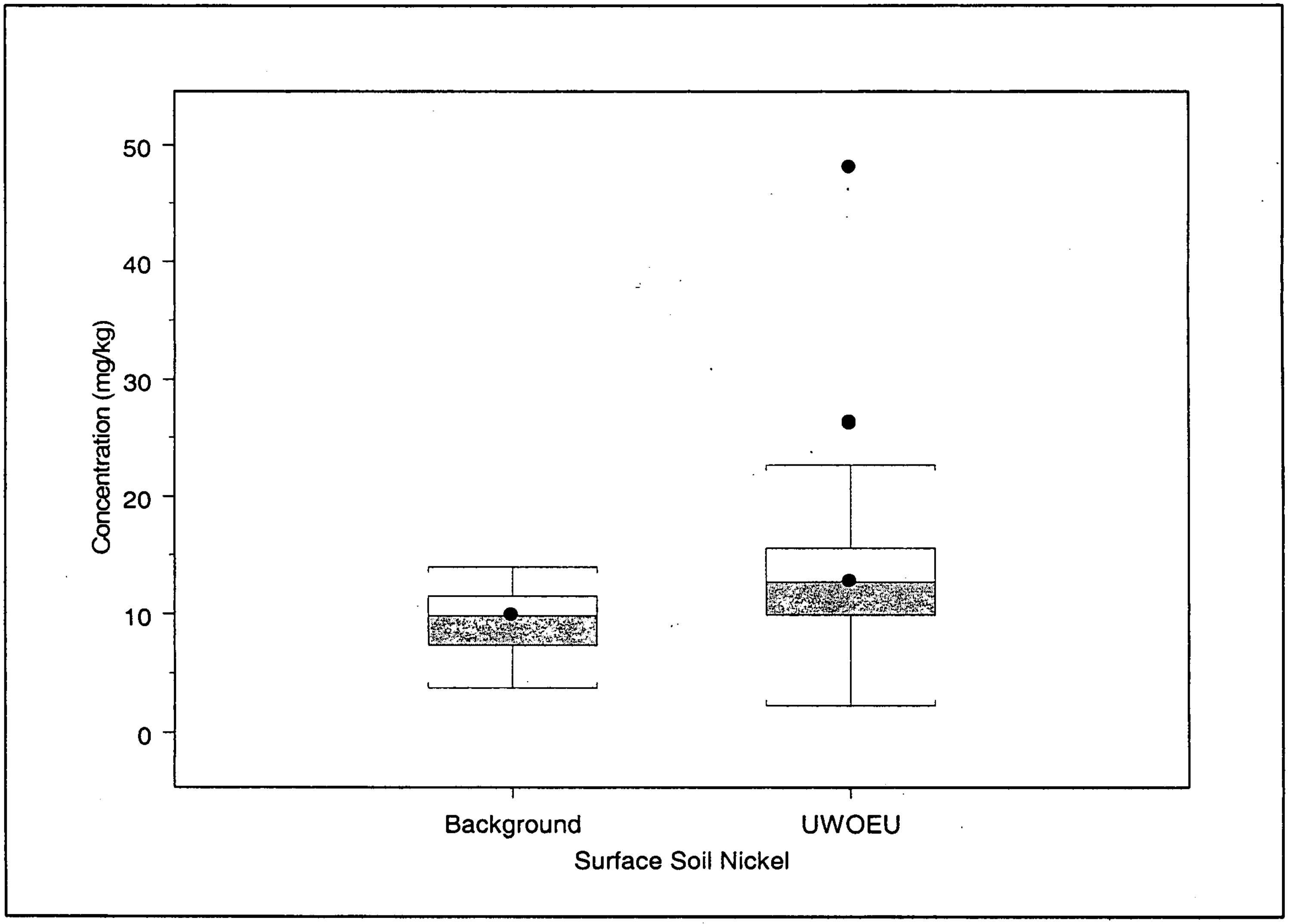

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figur[illegible].2.27**
**UWOEU Subsurface Soil Box Plots for Molybdenum**



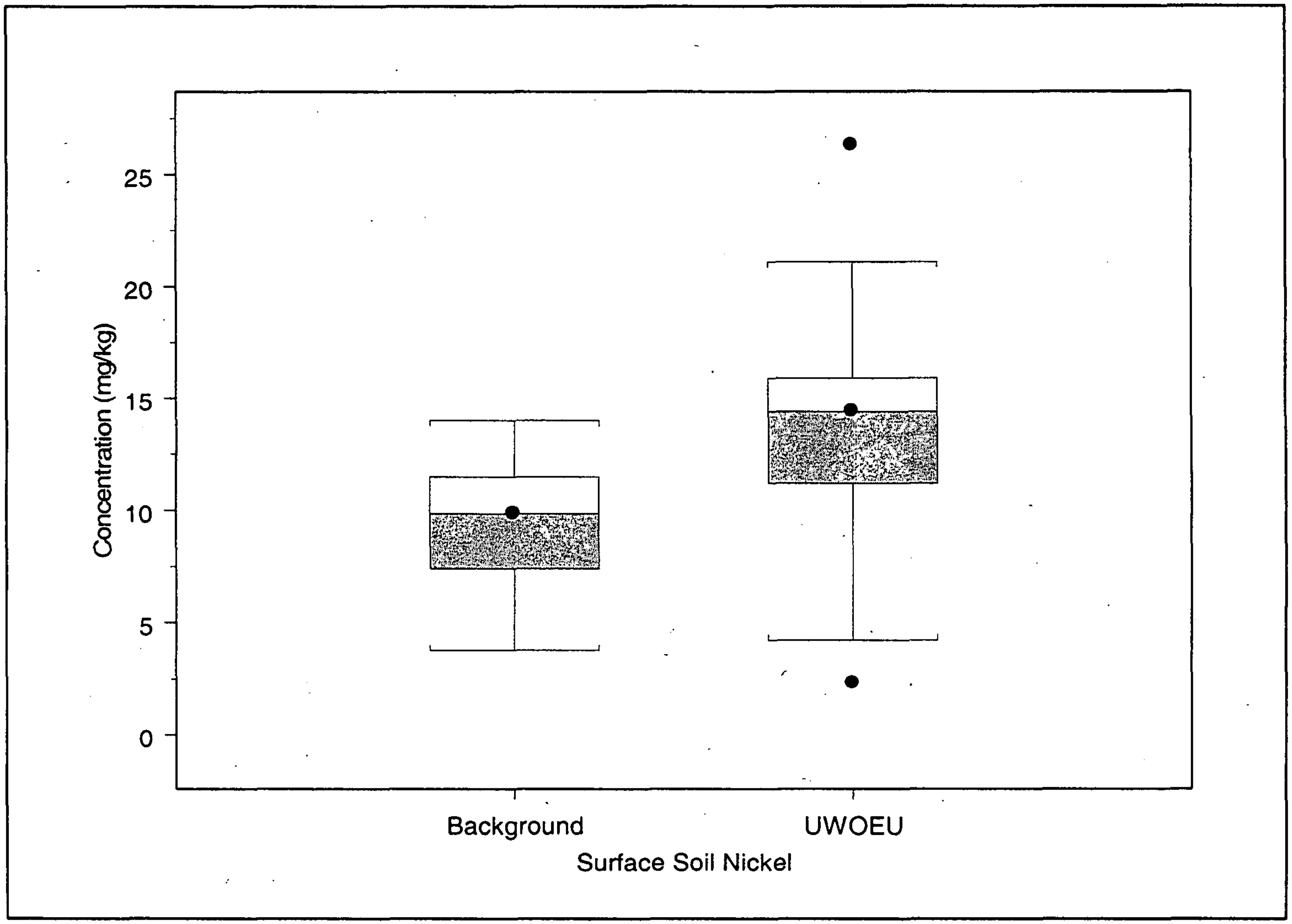

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figur[illegible].2.28**
**UWOEU Surface Soil Box Plots for Nickel**



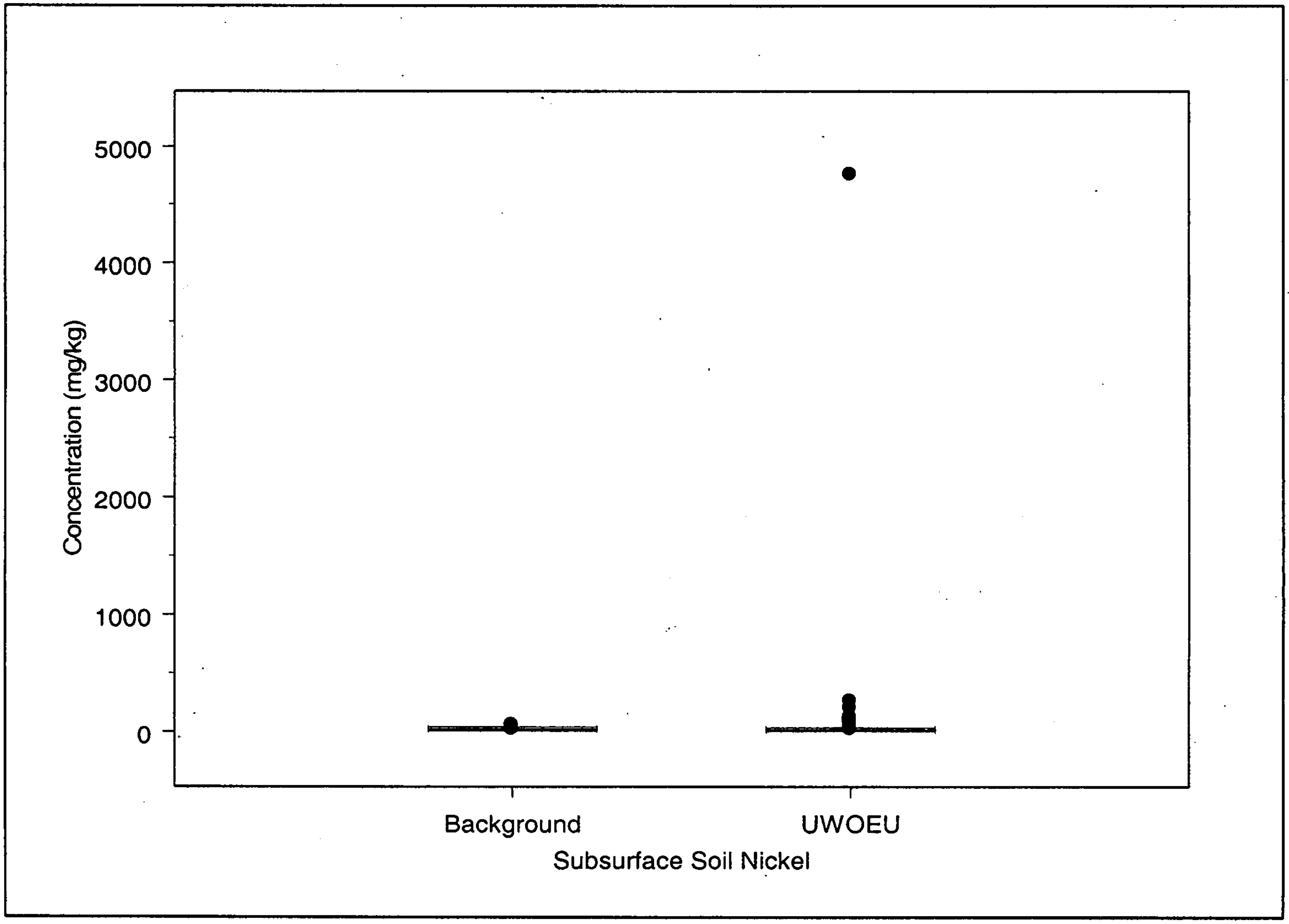

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure [illegible].2.29**
**UWOEU Surface Soil (PMJM) Box Plots for Nickel**



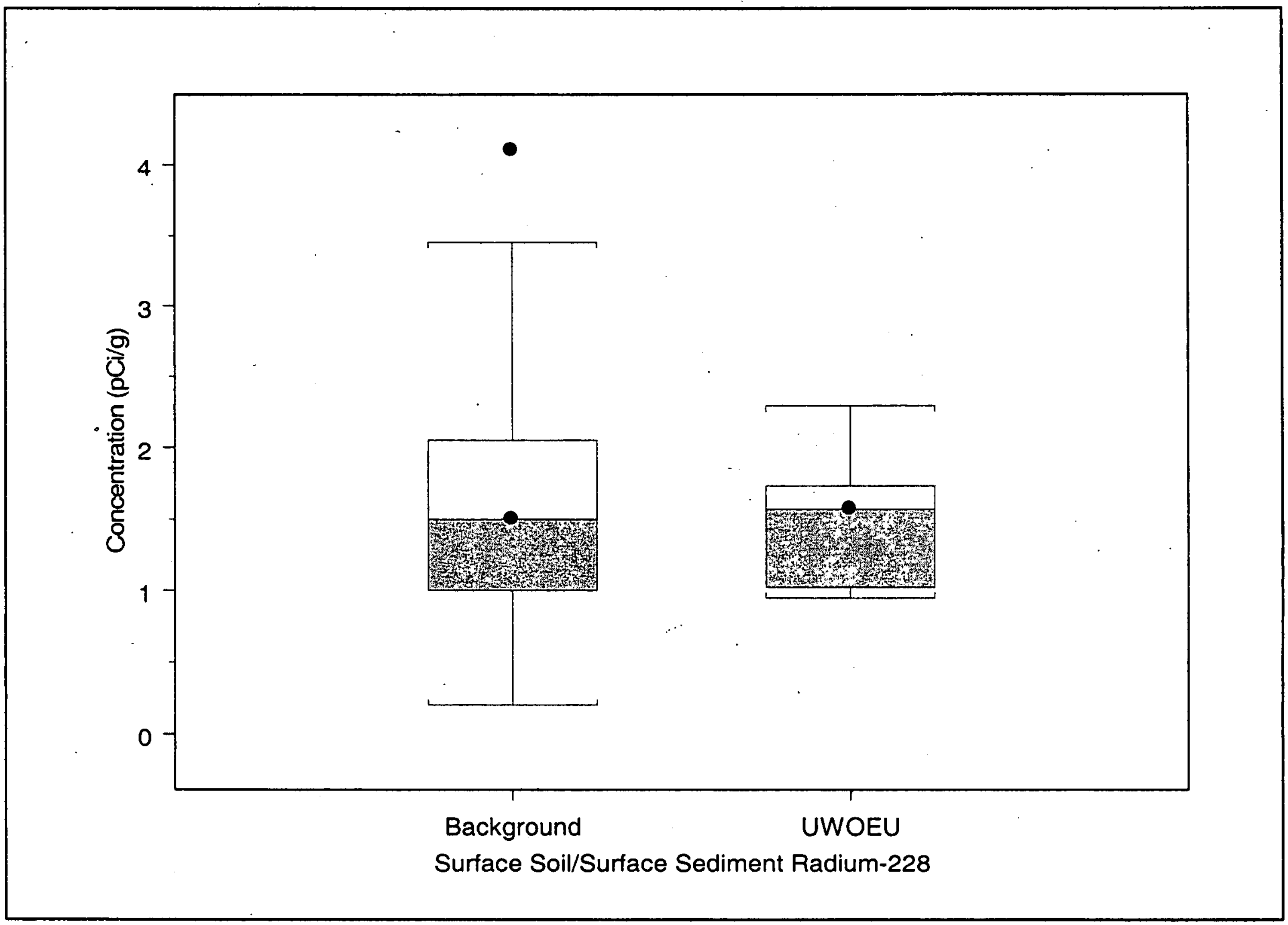

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible].2.30**
**UWOEU Subsurface Soil Box Plots for Nickel**



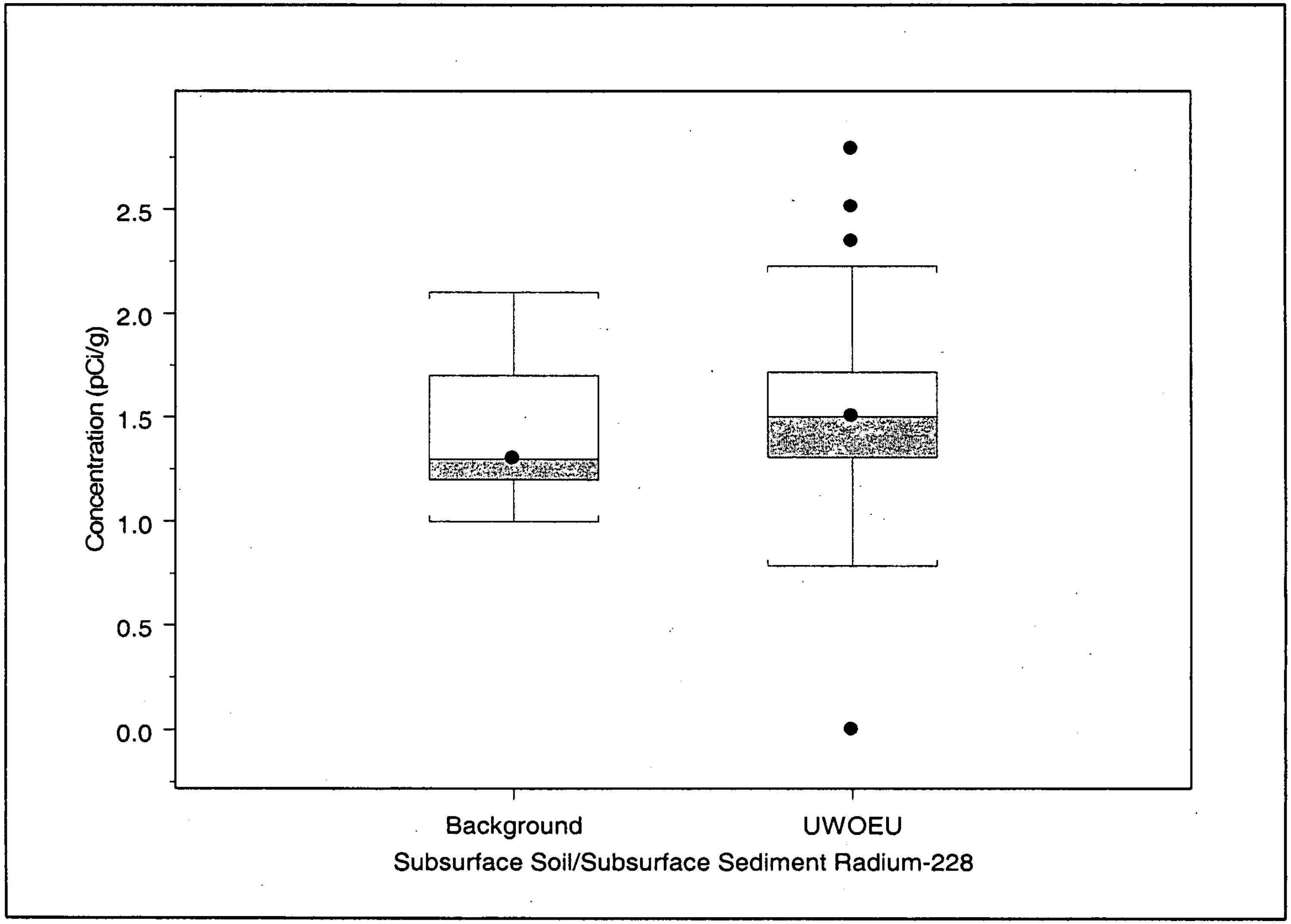

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure 3.2.31**
**UWOEU Surface Soil/Surface Sediment Box Plots for Radium-228**



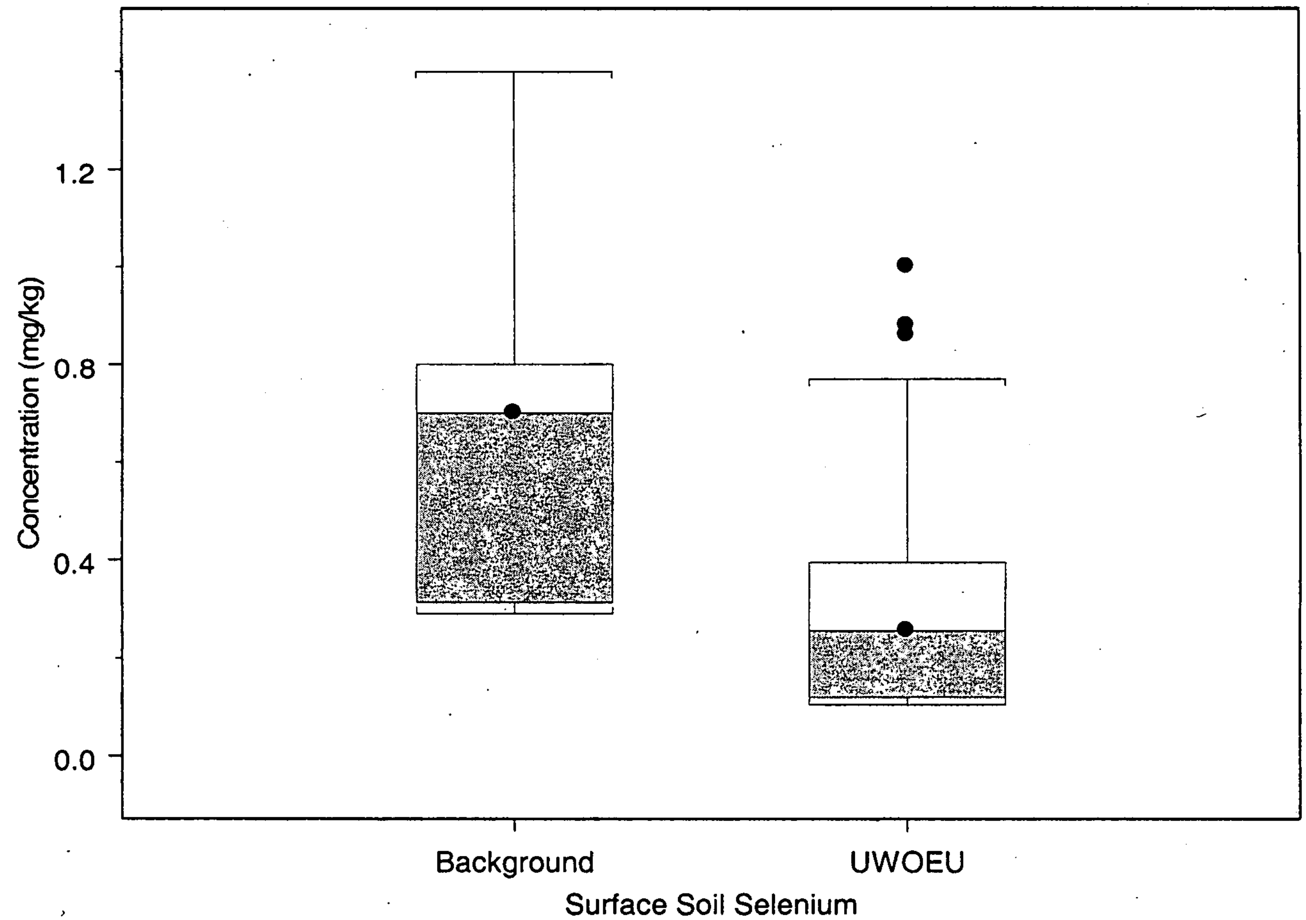

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible].2.32**
**UWOEU Subsurface Soil/Subsurface Sediment Box Plots for Radium-228**



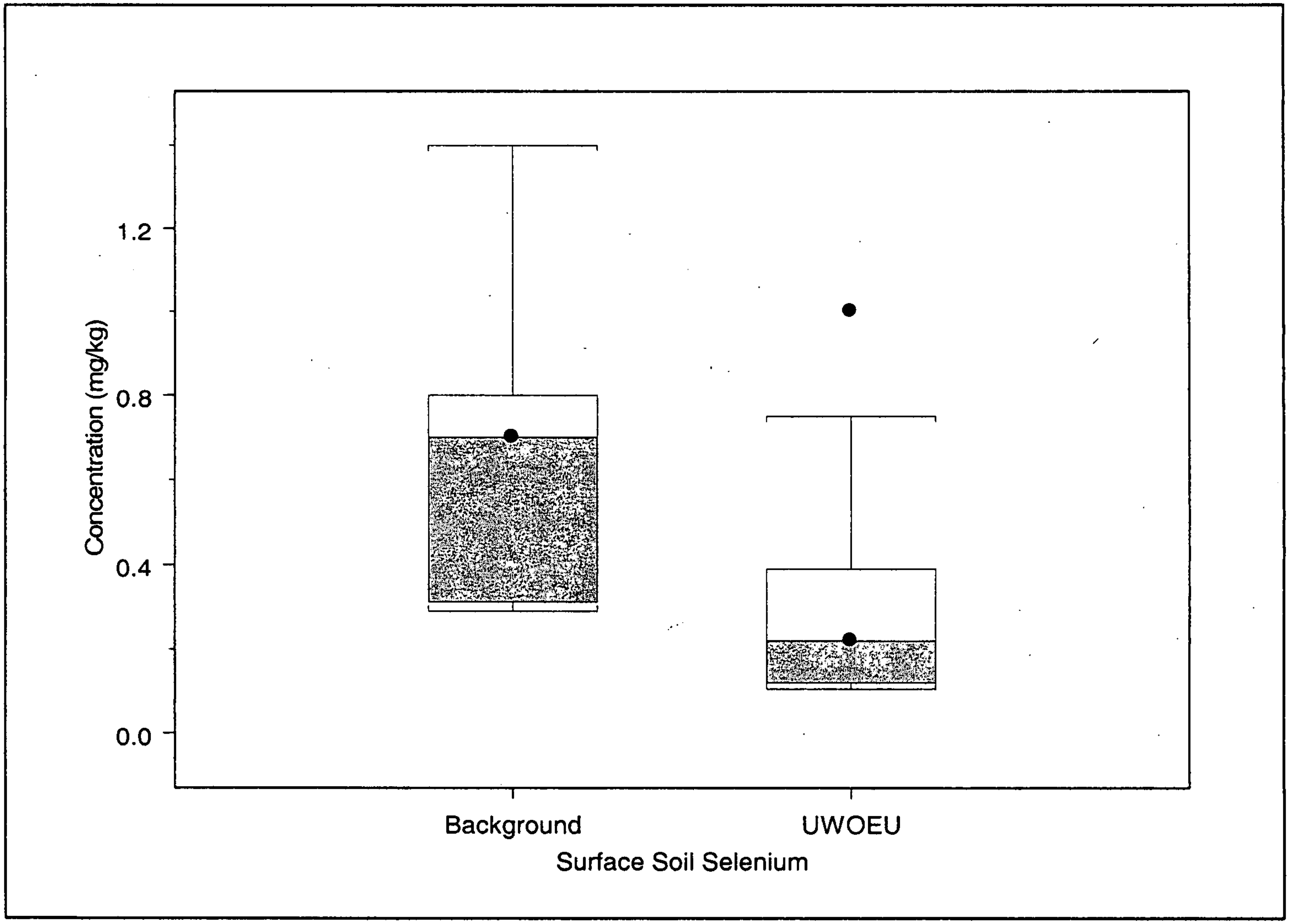

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure [illegible].2.33**
**UWOEU Surface Soil Box Plots for Selenium**



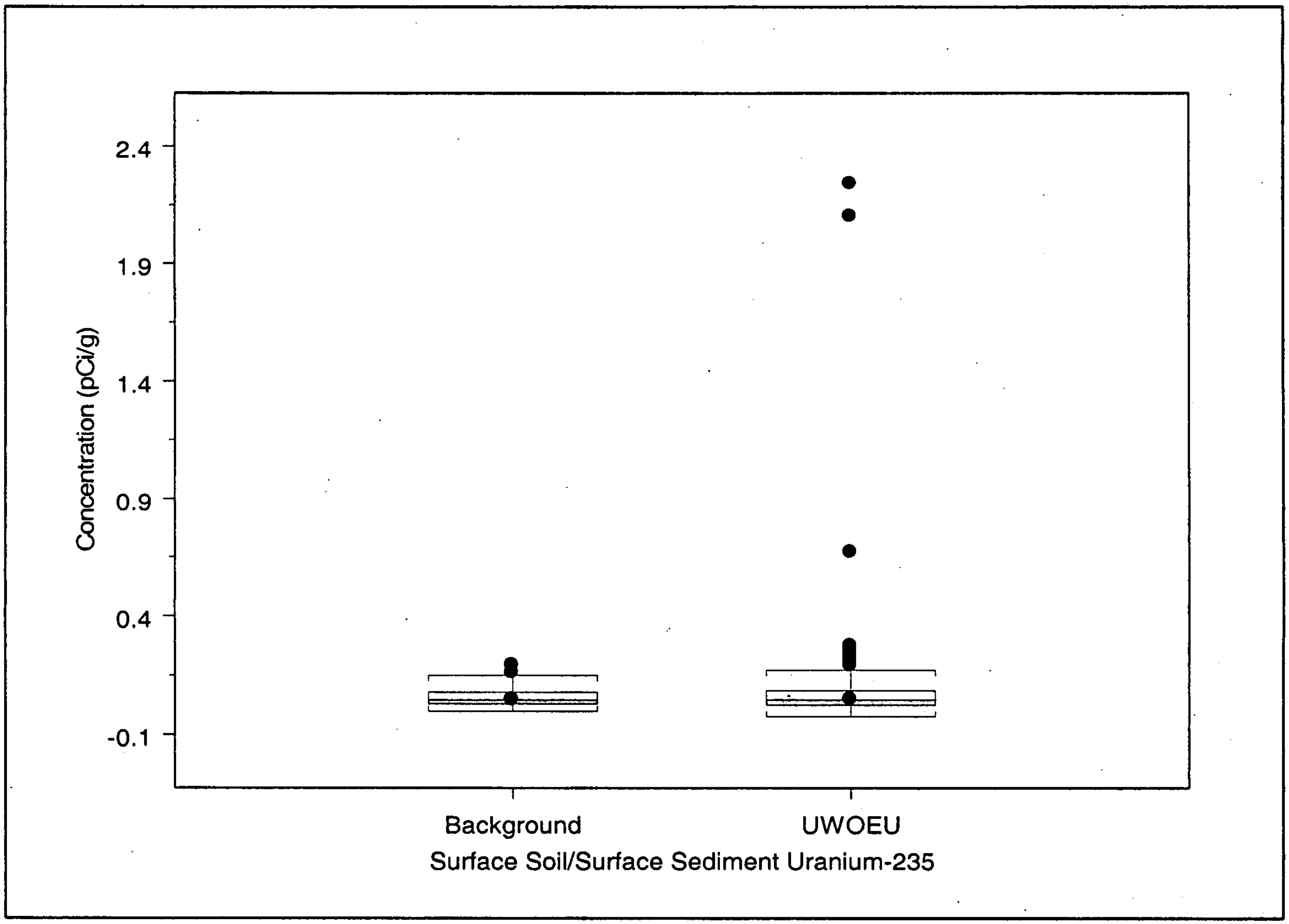

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figur[illegible]3.2.34**
**UWOEU Surface Soil (PMJM) Box Plots for Selenium**



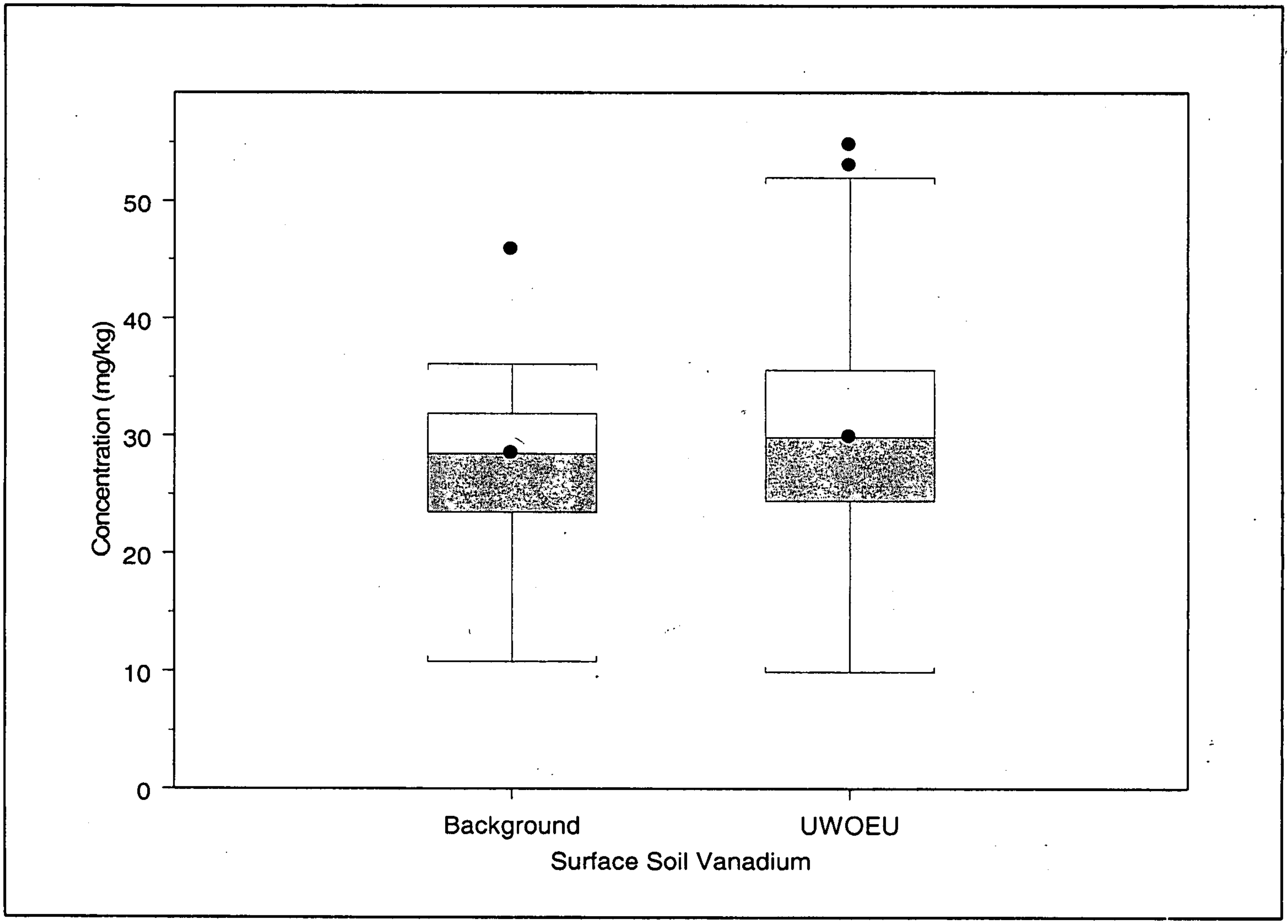

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure [illegible]3.2.35**
**UWOEU Surface Soil/Surface Sediment Box Plots for Uranium-235**



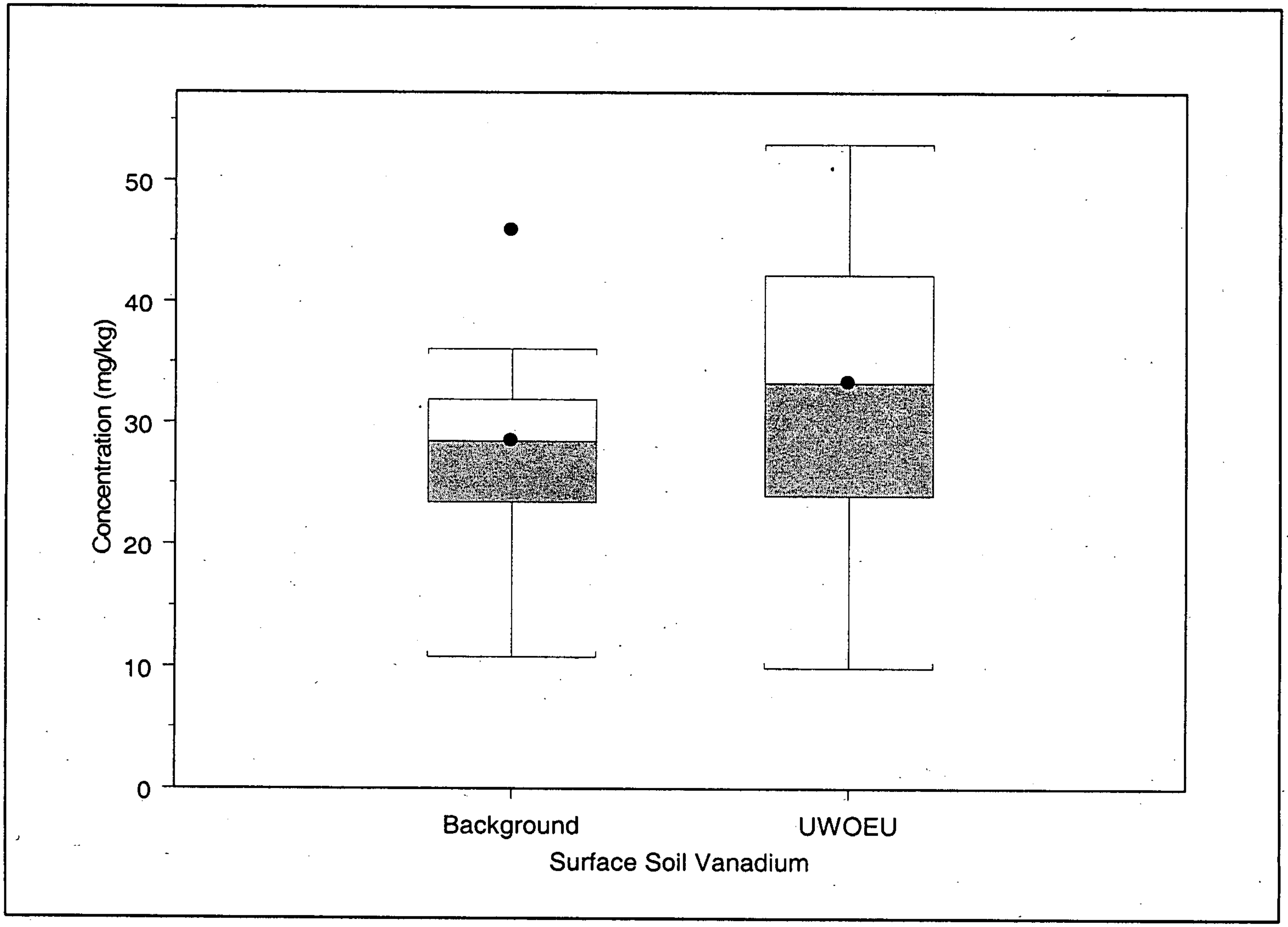

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible]3.2.36**
**UWOEU Surface Soil Box Plots for Vanadium**



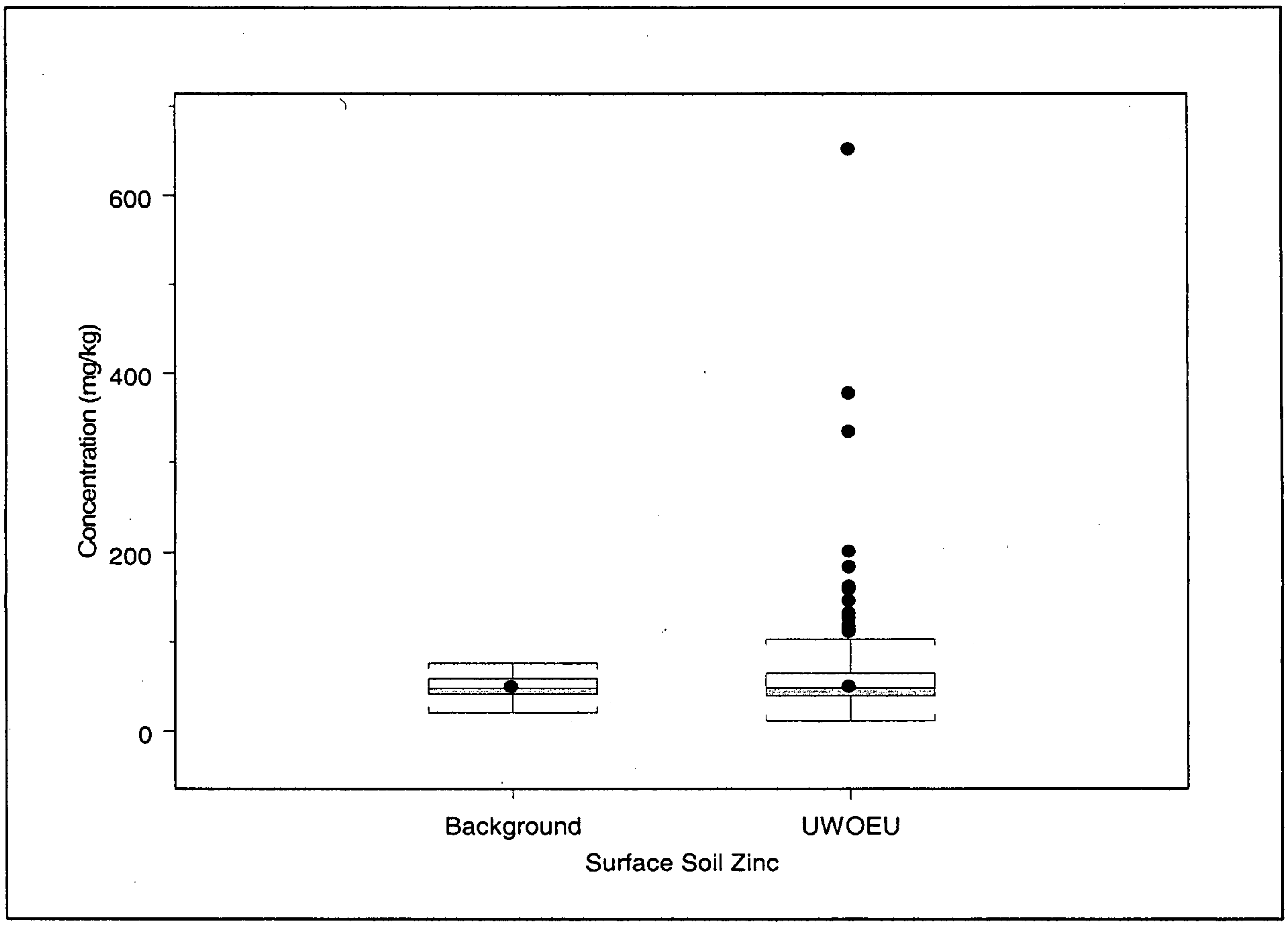

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible]3.2.37**
**UWOEU Surface Soil (PMJM) Box Plots for Vanadium**



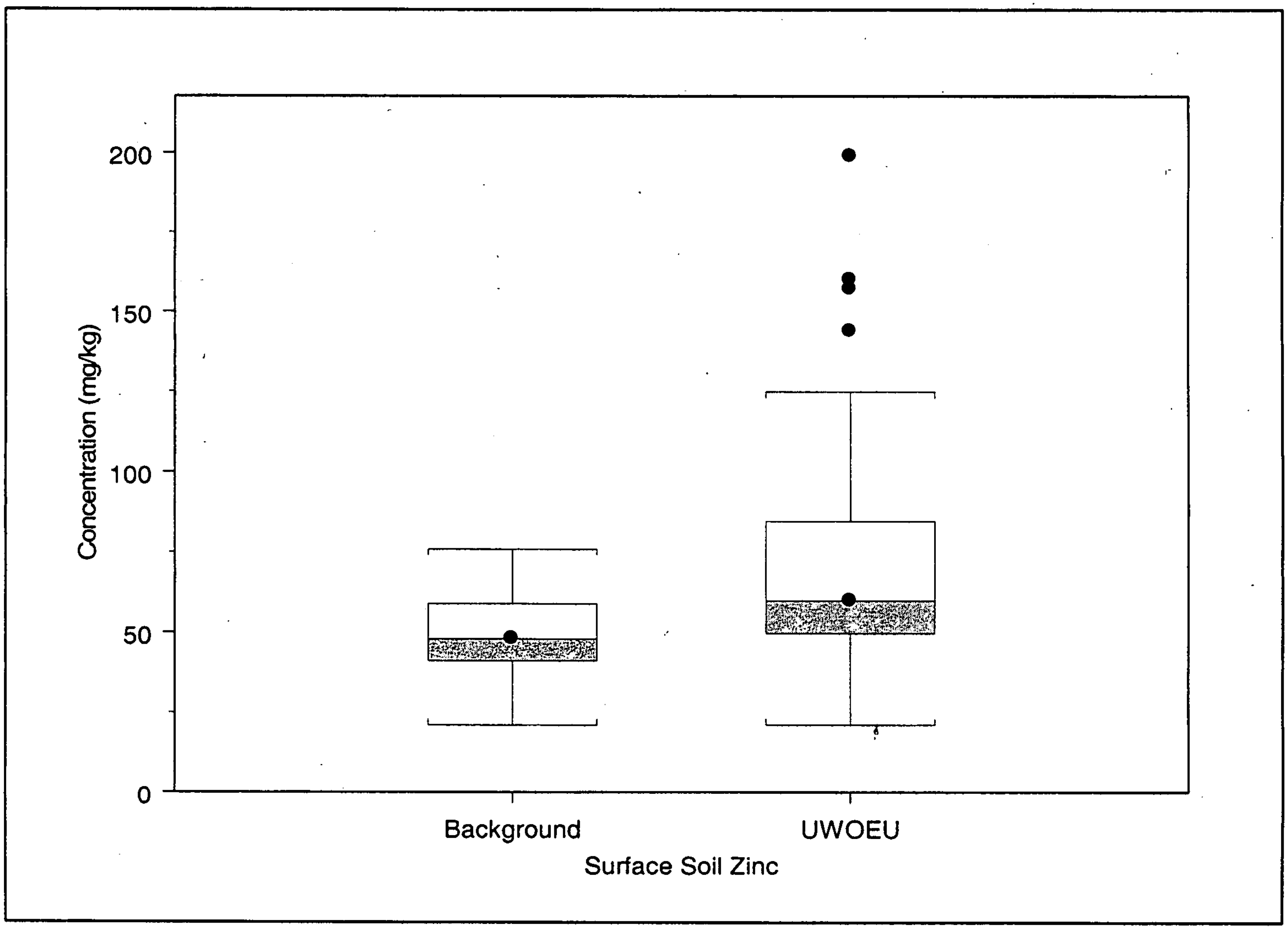

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible]3.2.38**
**UWOEU Surface Soil Box Plots for Zinc**



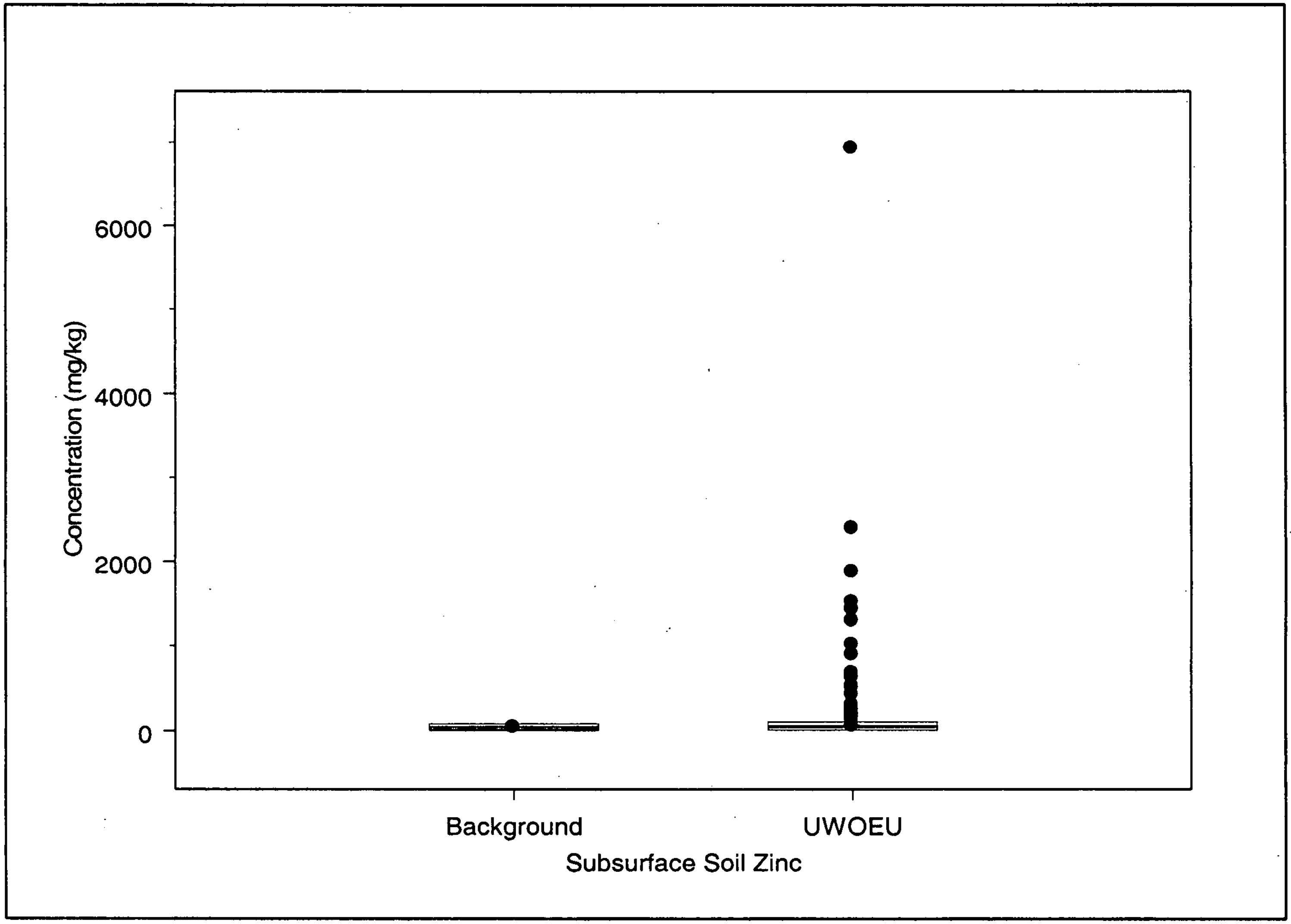

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figu[illegible]3.2.39**
**UWOEU Surface Soil (PMJM) Box Plots for Zinc**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

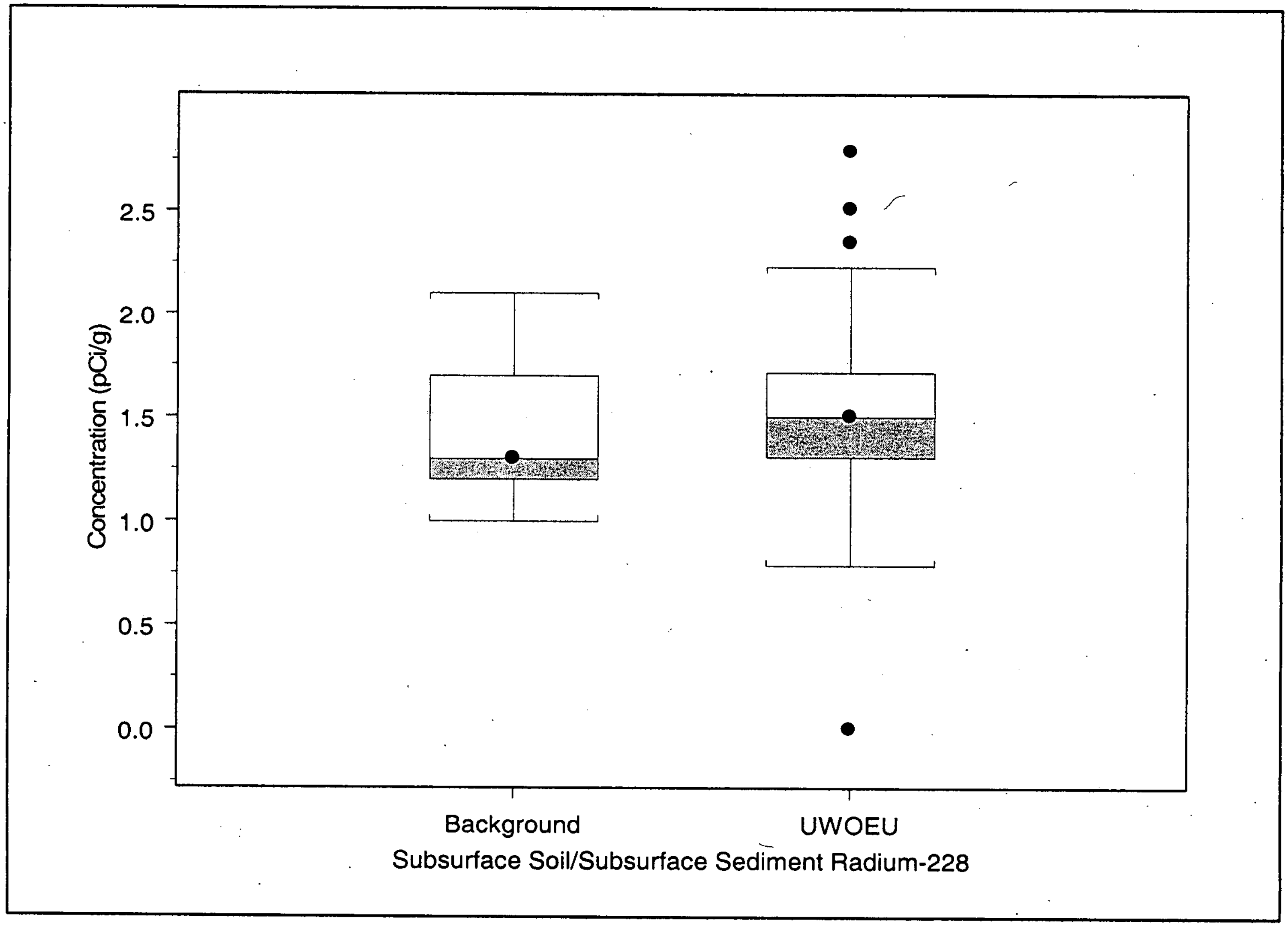
**Figu[illegible]3.2.40**
**UWOEU Subsurface Soil Box Plots for Zinc**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

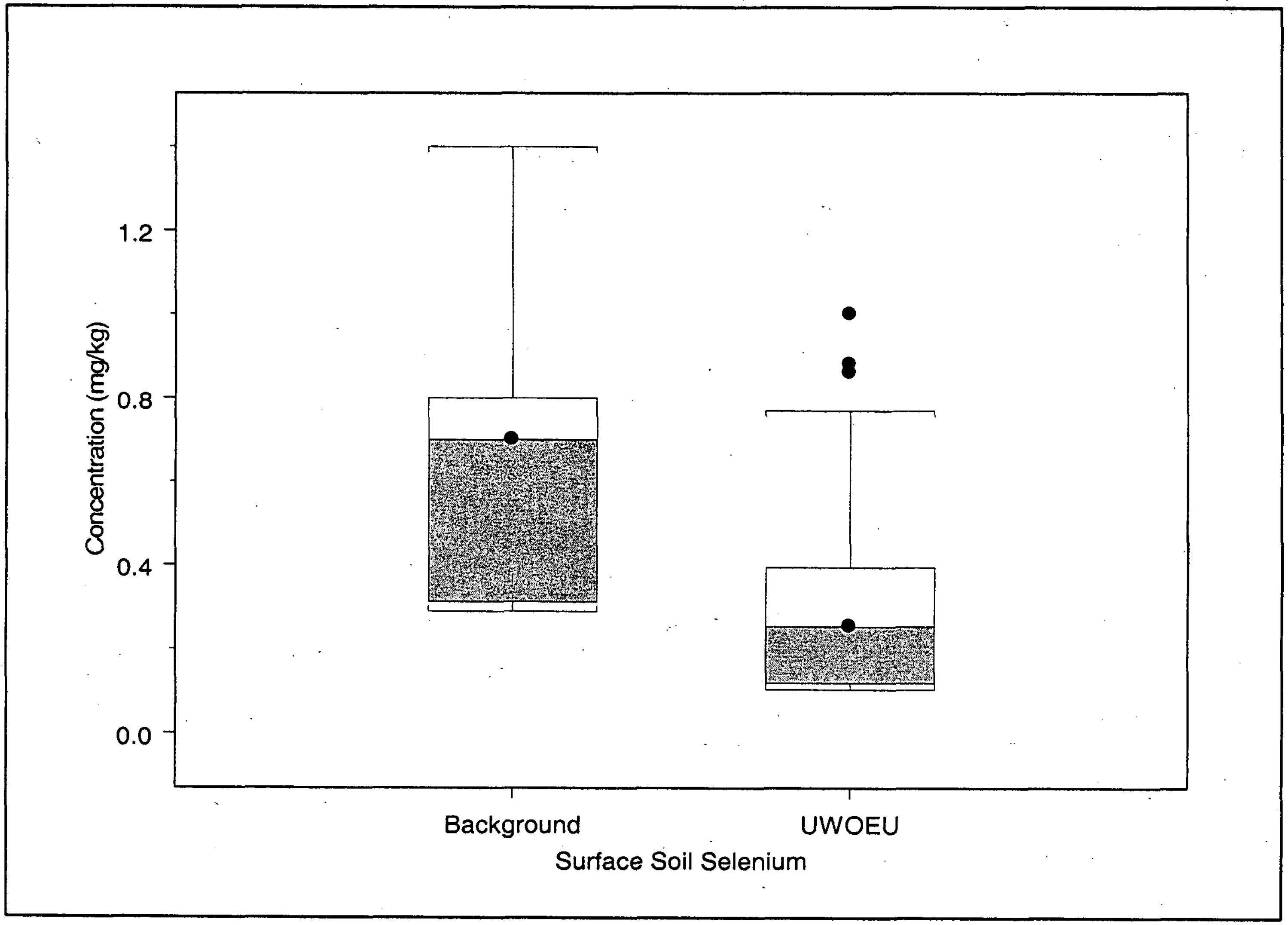
**Figure 3.2.32**

**UWOEU Subsurface Soil/Subsurface Sediment Box Plots for Radium-228**



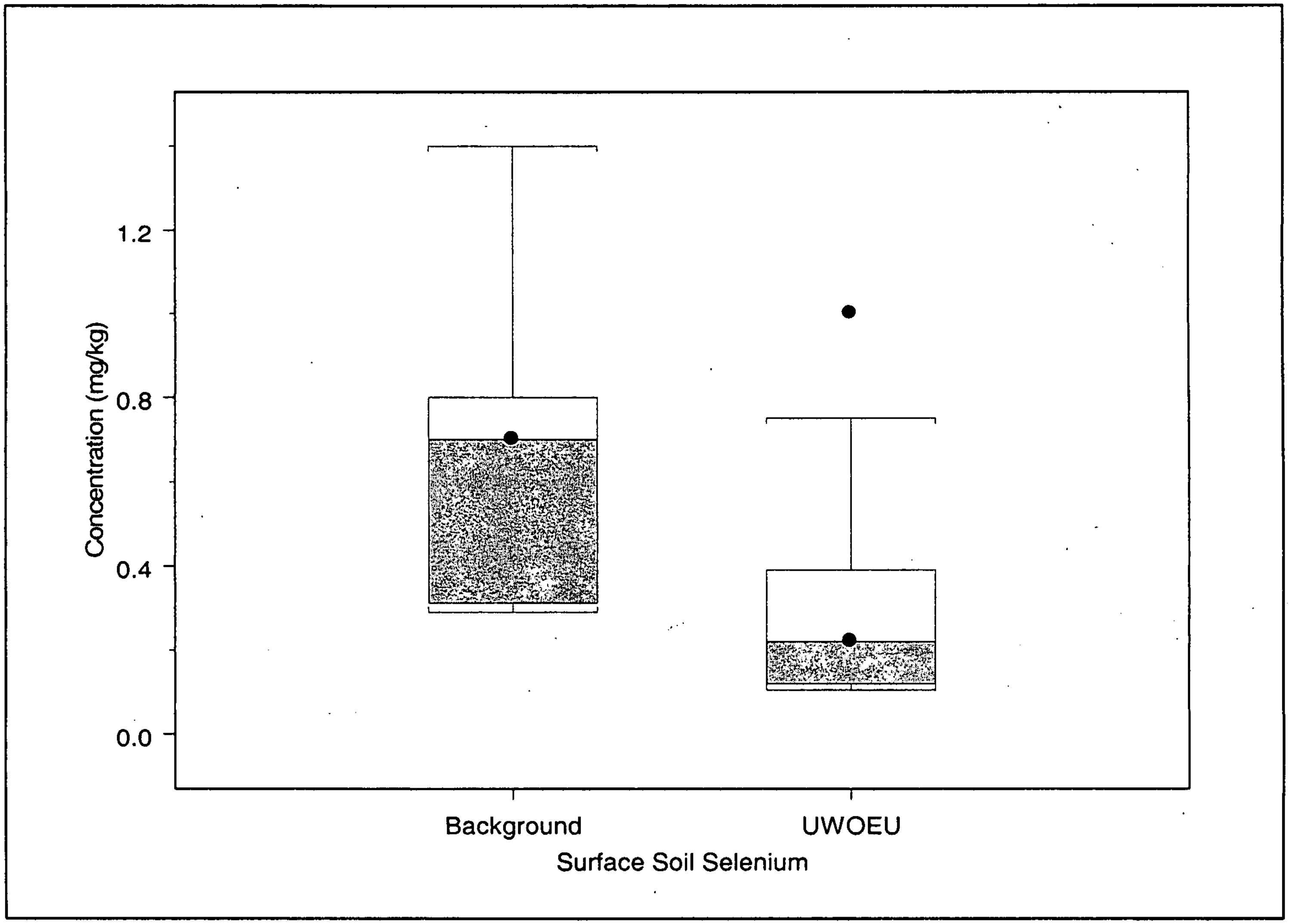

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure A3.2.33**
**UWOEU Surface Soil Box Plots for Selenium**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

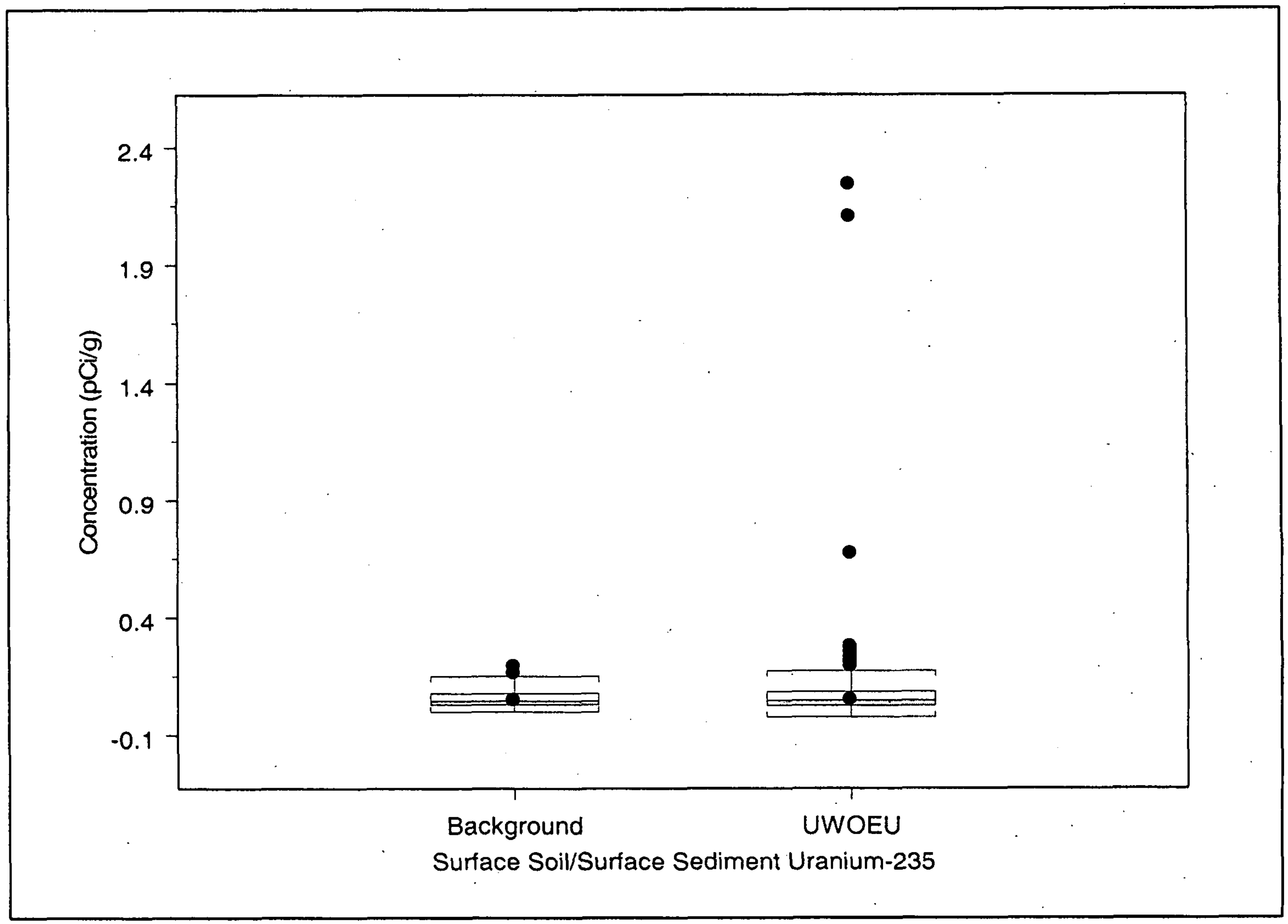
**Figure A3.2.34**
**UWOEU Surface Soil (PMJM) Box Plots for Selenium**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

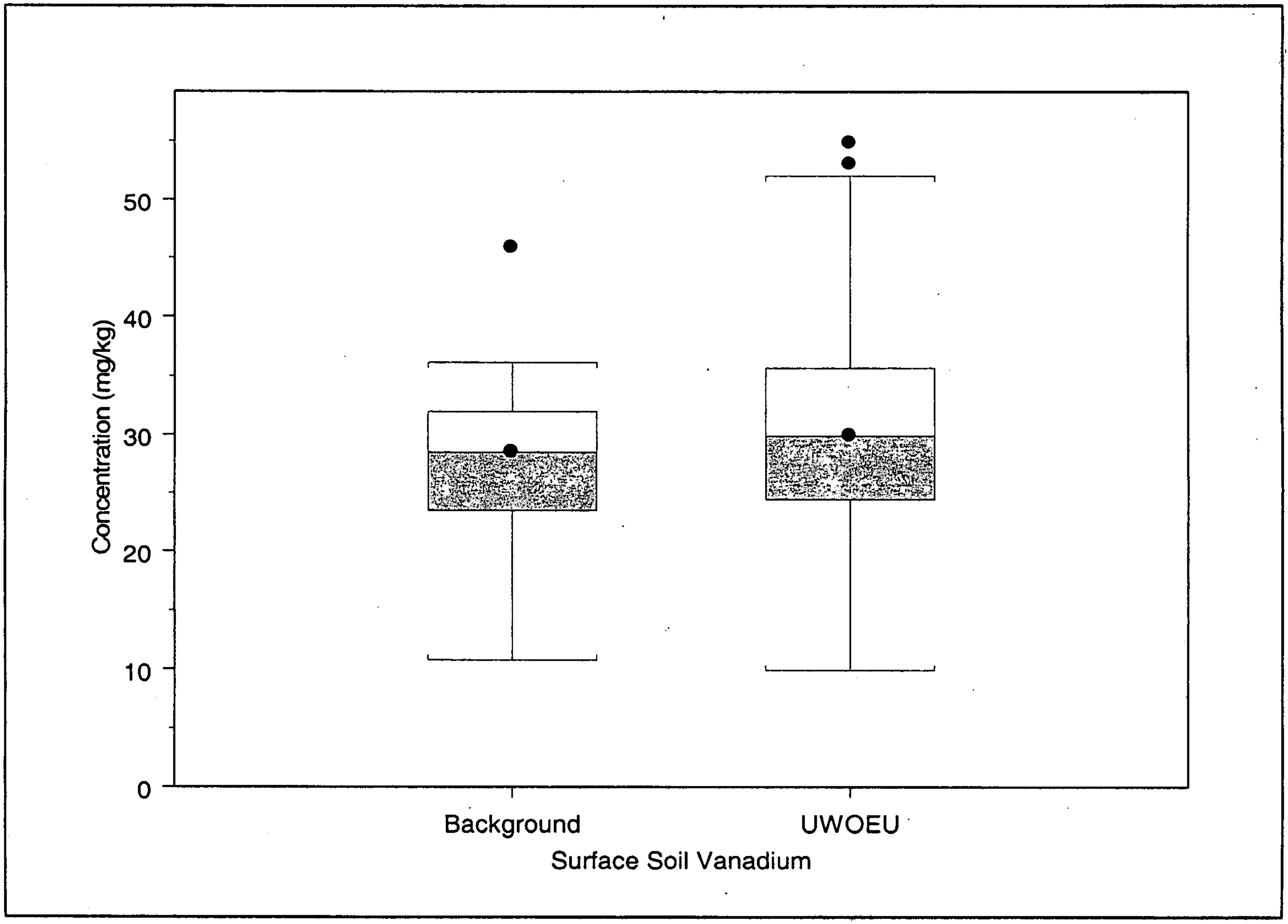
Figure A3.2.35

**UWOEU Surface Soil/Surface Sediment Box Plots for Uranium-235**



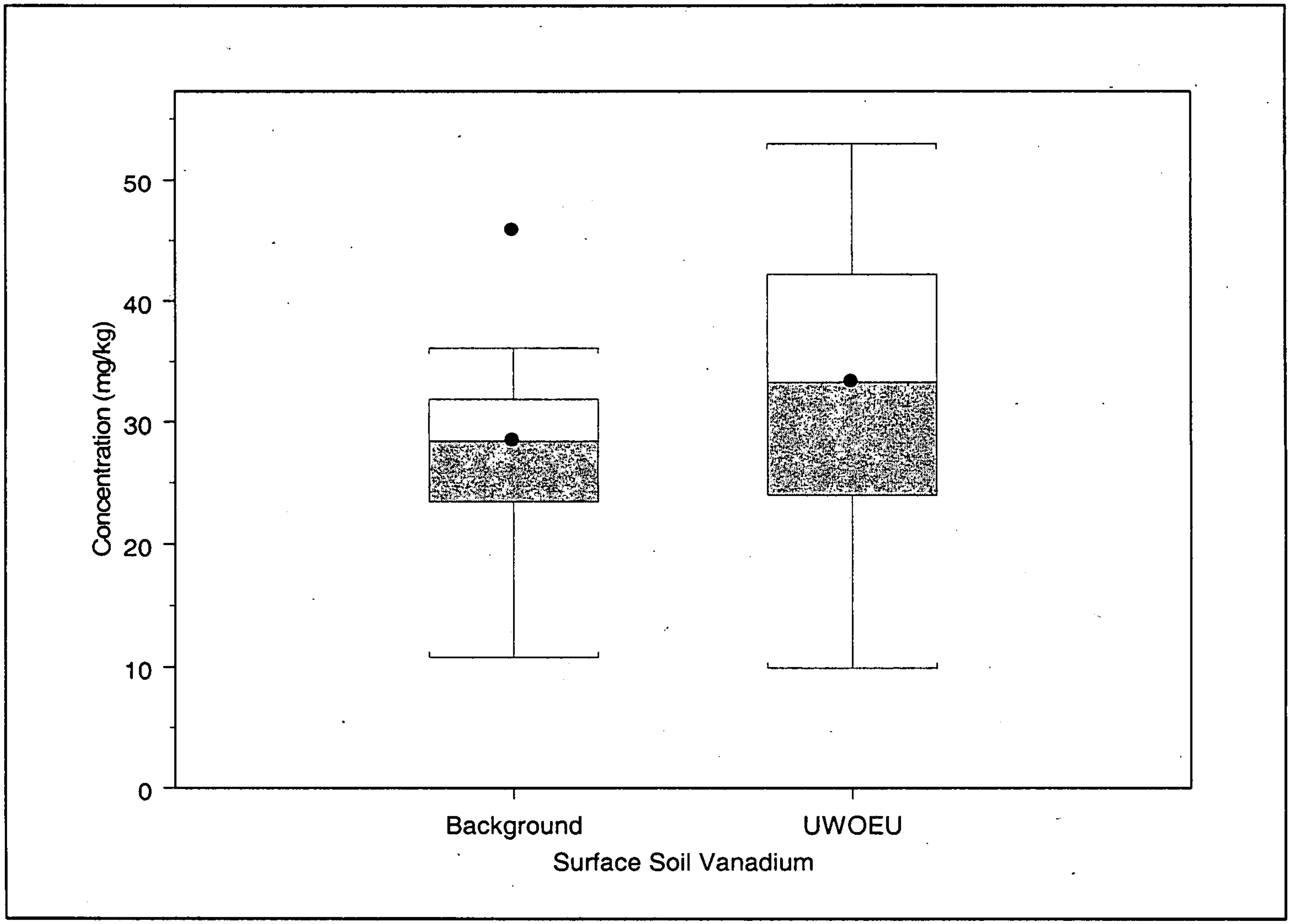

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure A3.2.36**
**UWOEU Surface Soil Box Plots for Vanadium**



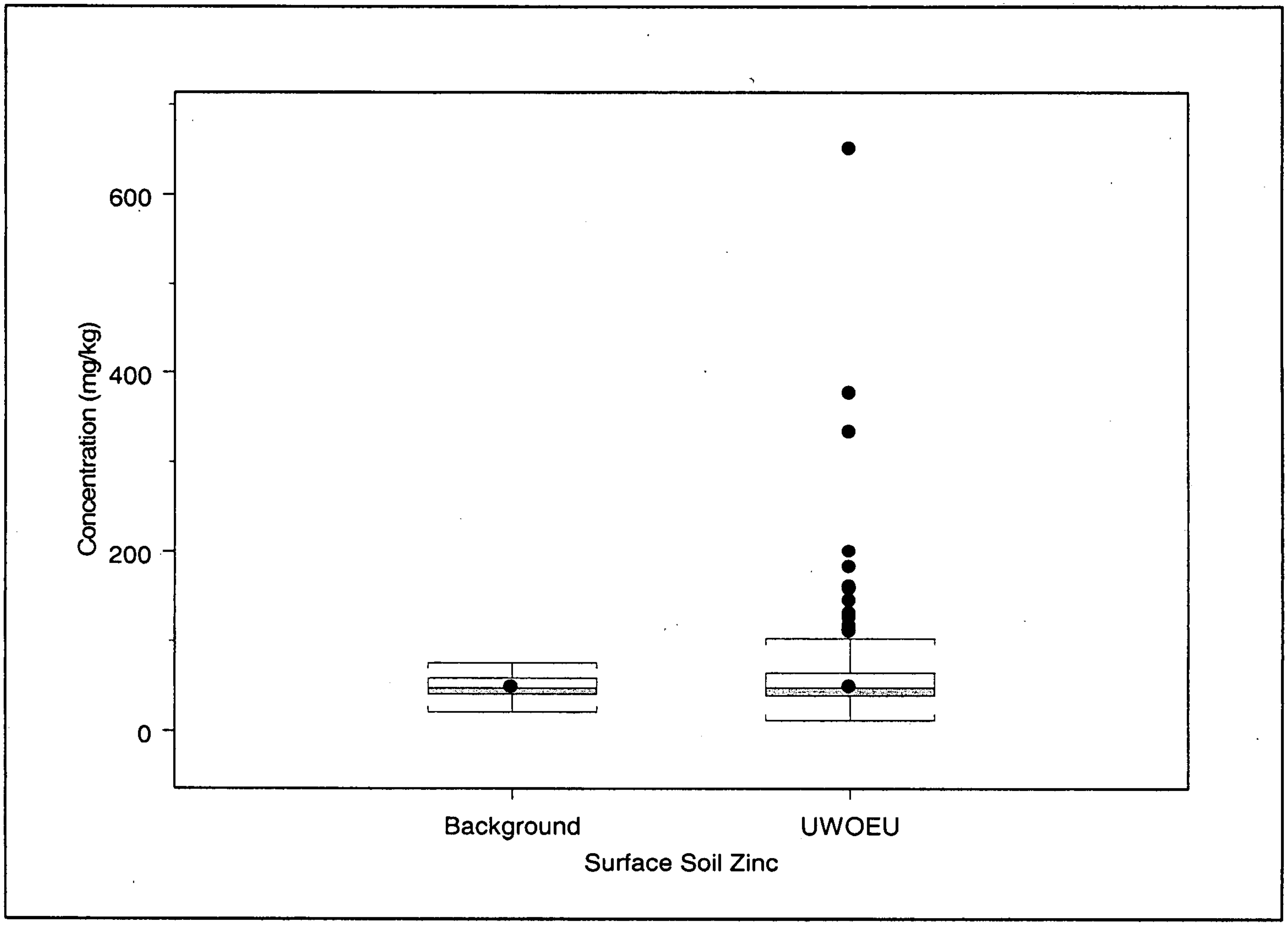

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure A3.2.37**
**UWOEU Surface Soil (PMJM) Box Plots for Vanadium**



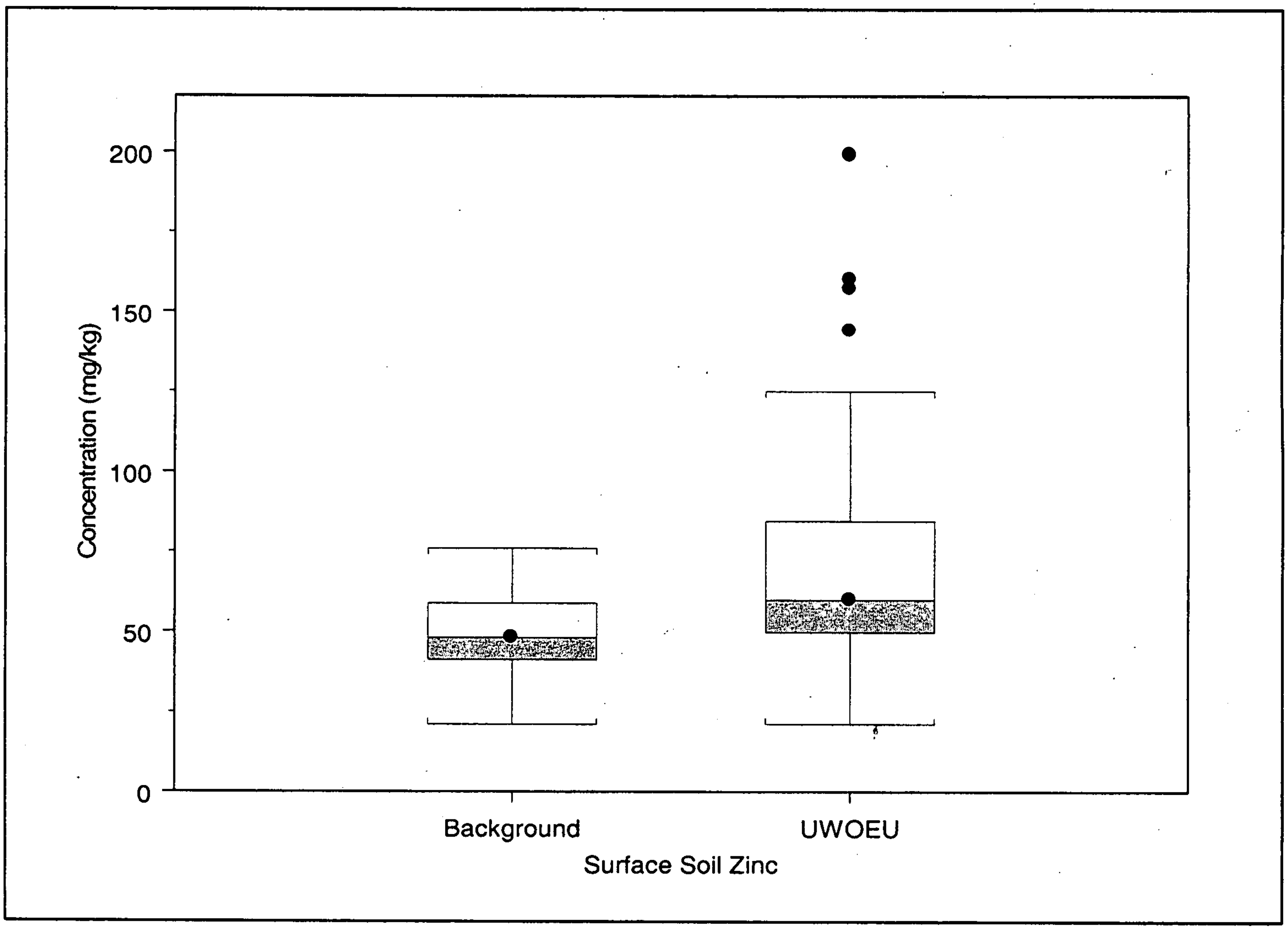

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure A3.2.38**
**UWOEU Surface Soil Box Plots for Zinc**



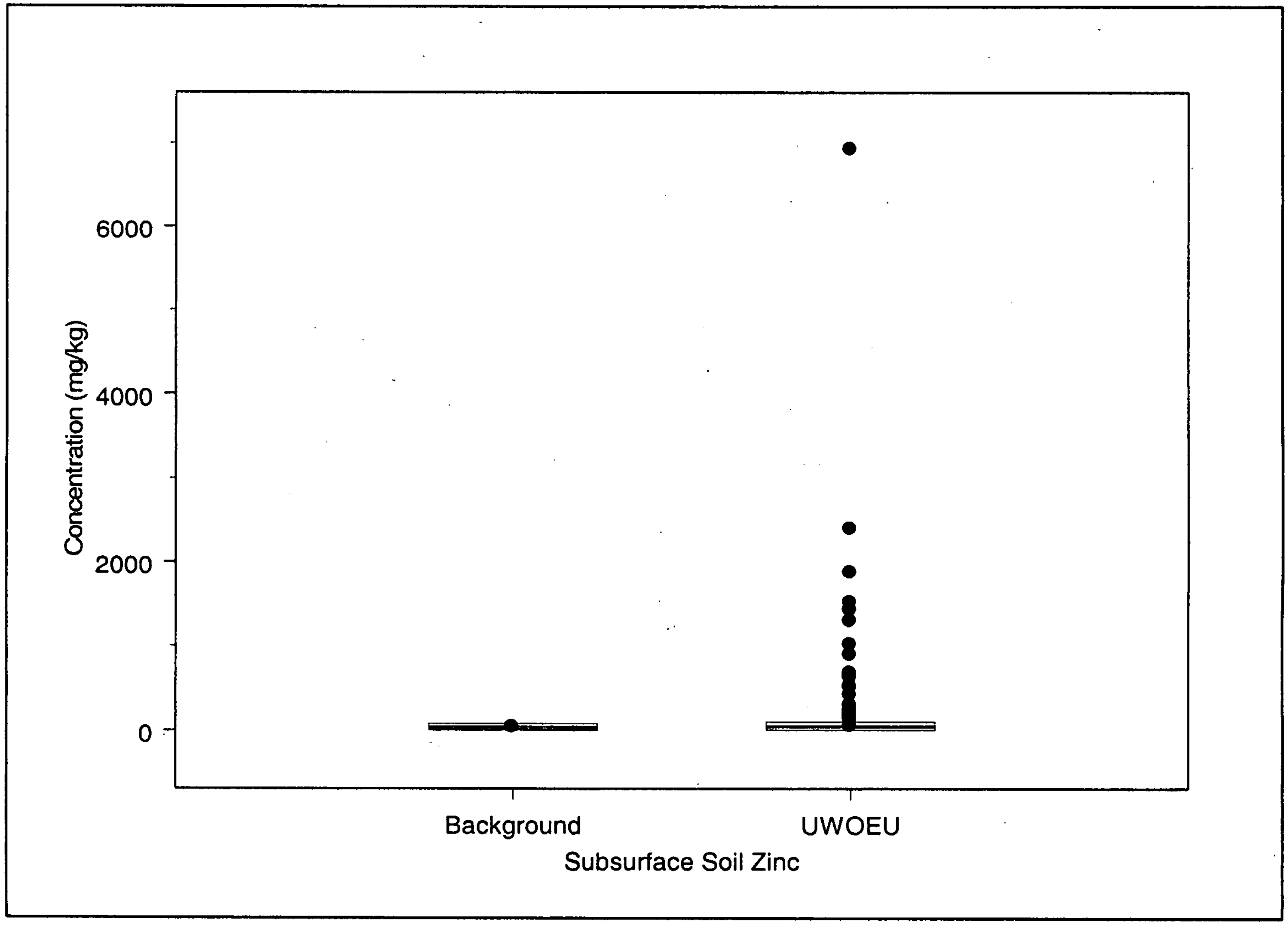

Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure A3.2.39**
**UWOEU Surface Soil (PMJM) Box Plots for Zinc**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

**Figure A3.2.40**
**UWOEU Subsurface Soil Box Plots for Zinc**




Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

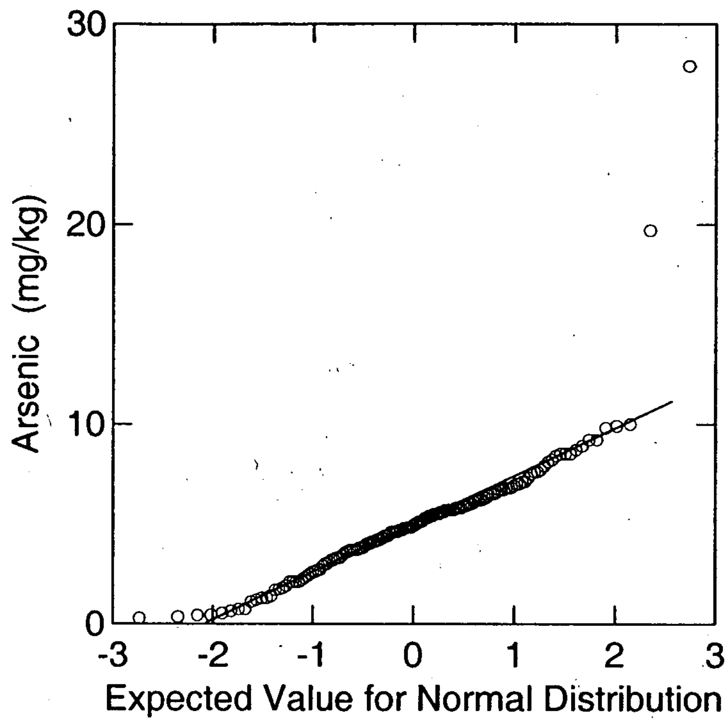
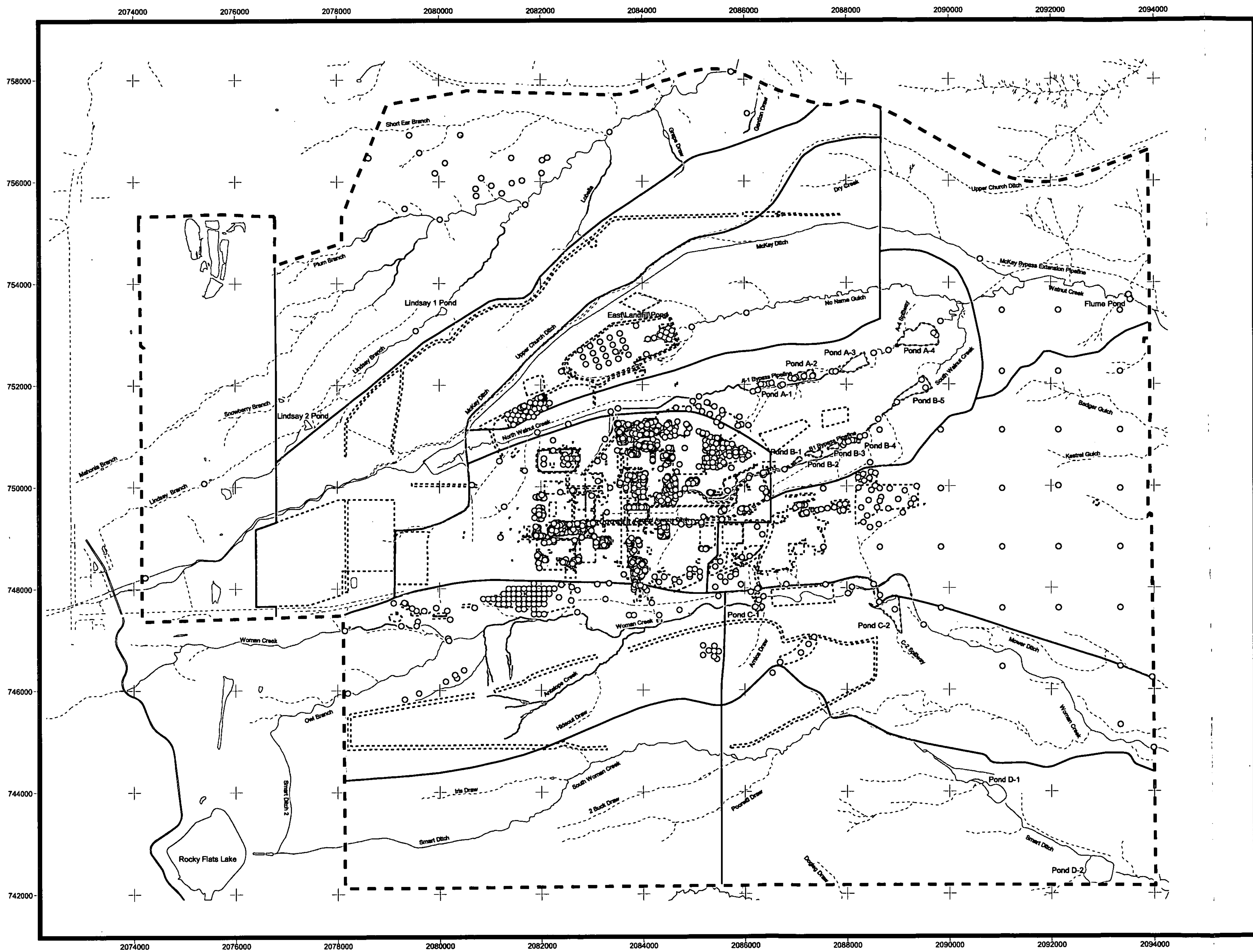



**Figure A3.4.1.** **Probability Plot for Arsenic Concentrations in UWOEU Surface Soil/Surface Sediment**

# Figure A3.4.2

## Benzo(a)pyrene Concentrations in Sitewide Surface Soil/Surface Sediment




## KEY

- O Concentration > 3x WRW PRG
- O Concentration > WRW PRG and <= 3x WRW PRG
- O Concentration <= WRW PRG
- O Nondetect (ND)

WRW PRG = 379 ug/kg
3 x WRW PRG = 1,137 ug/kg

### Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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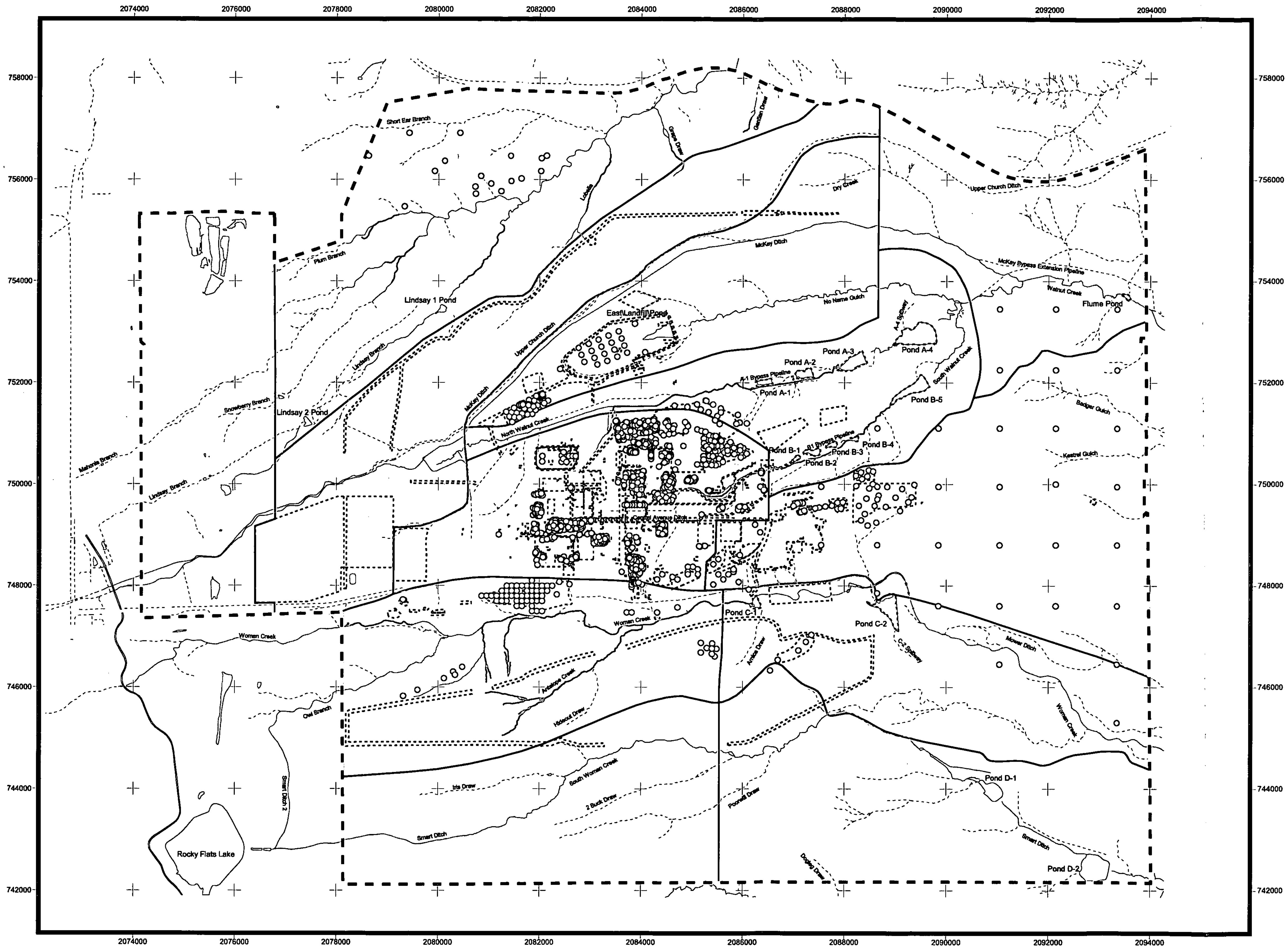


**Figure A3.4.3**

**Bis(2-ethylhexyl)phthalate Concentrations in Sitewide Surface Soil (Non-PMJM)**

## KEY

- O Concentration > 3x ESL
- O Concentration > ESL and <= 3x ESL
- O Concentration <= ESL
- O Nondetect (ND)

Min. Non-PMJM ESL = 137 ug/kg
3 x Min. Non-PMJM ESL = 410 ug/kg

**Standard Map Features**

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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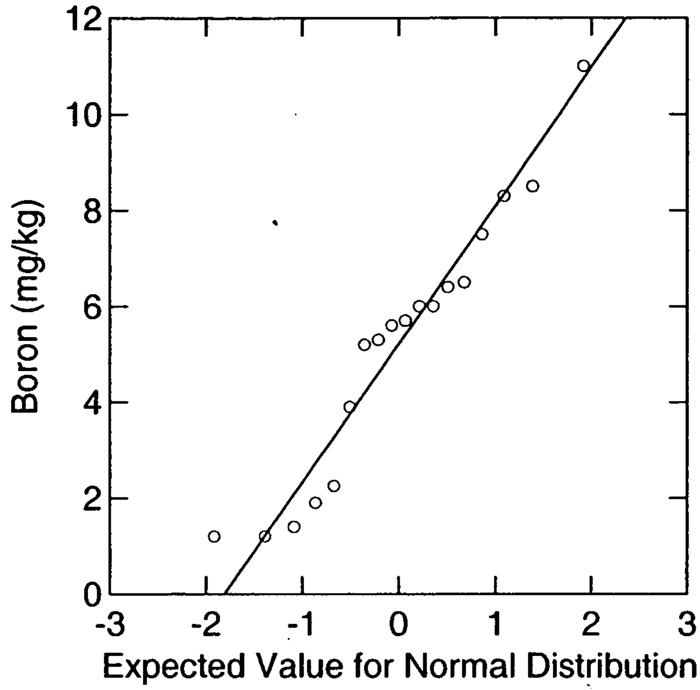
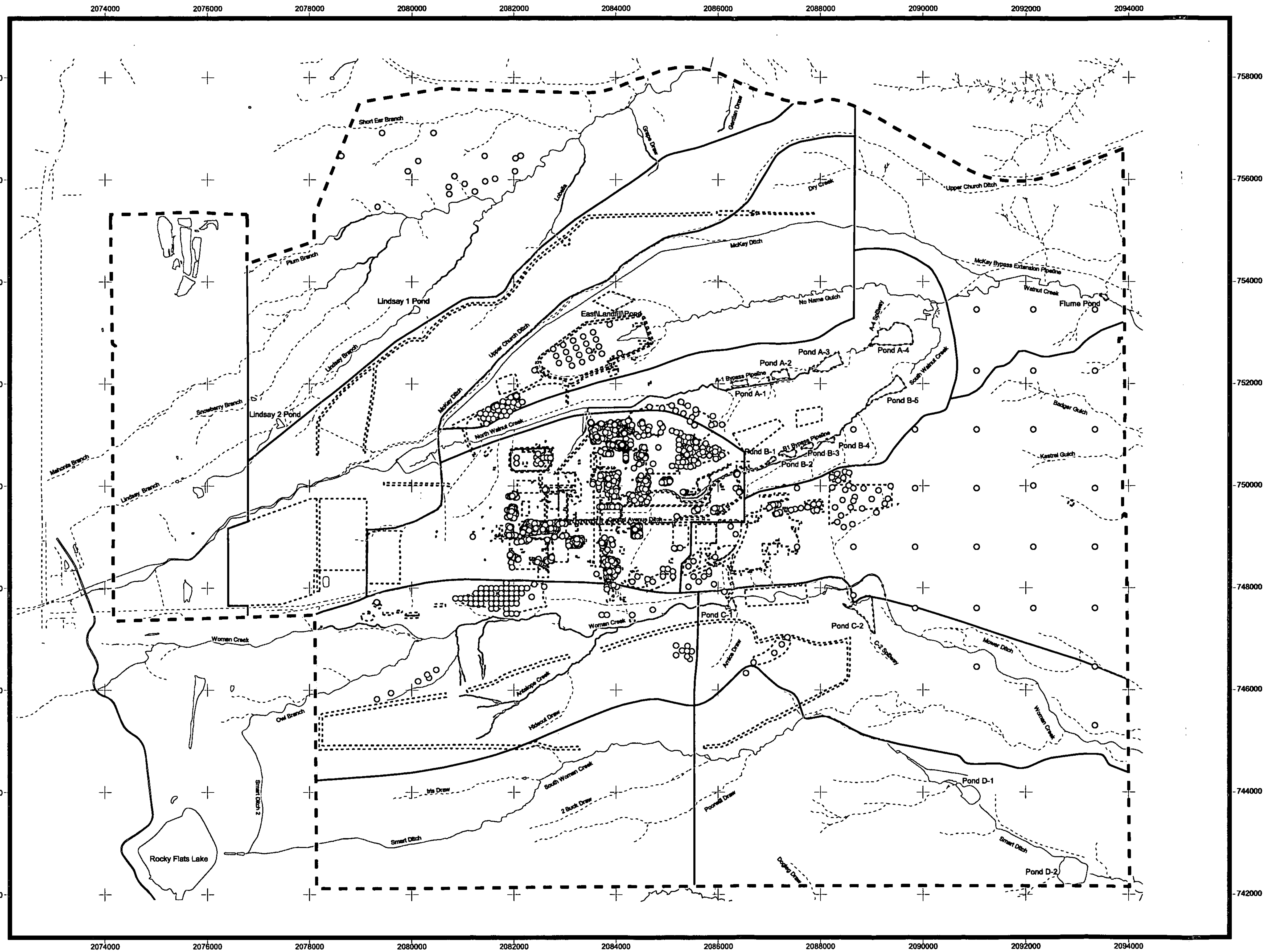



**Figure A3.4.4. Probability Plot for Boron Concentrations in the UWOEU Surface Soil**




# Figure A3.4.5

**Di-n-butylphthalate Concentrations in Sitewide Surface Soil (Non-PMJM)**

## KEY

- O Concentration > 3x ESL
- O Concentration > ESL and <= 3x ESL
- O Concentration <= ESL
- O Nondetect (ND)

Min. Non-PMJM ESL = 15.9 ug/kg
3 x Min. Non-PMJM ESL = 47.6 ug/kg

**Standard Map Features**

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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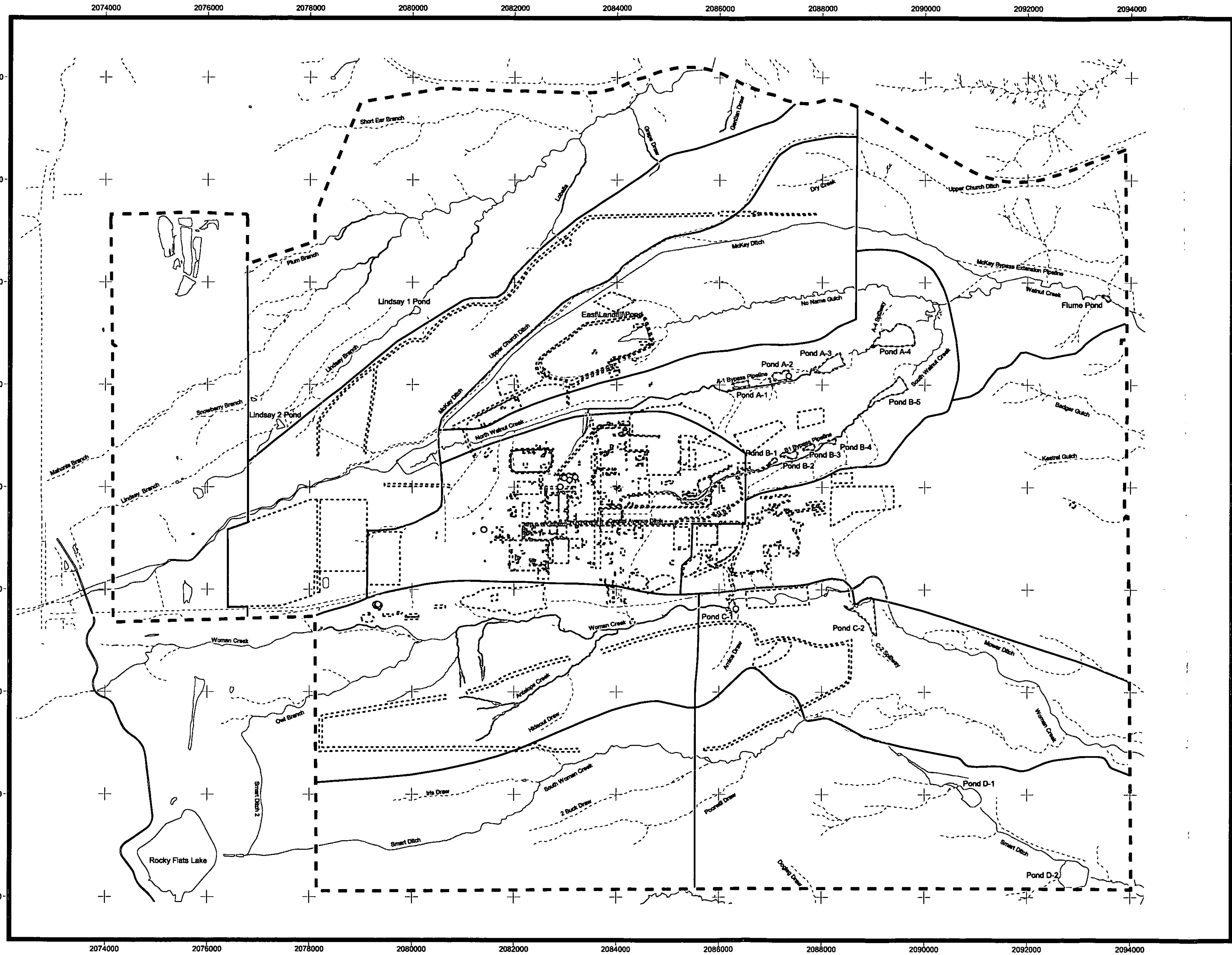


**Figure A3.4.6**

**2,3,7,8-TCDD TEQ Concentrations in Sitewide Surface Soil/Surface Sediment**

## KEY

- O Concentration > 3x WRW PRG
- O Concentration > WRW PRG and <= 3x WRW PRG
- O Concentration <= WRW PRG
- O Nondetect (ND)

WRW PRG = 0.025 ug/kg
3 x WRW PRG = 0.075 ug/kg

### Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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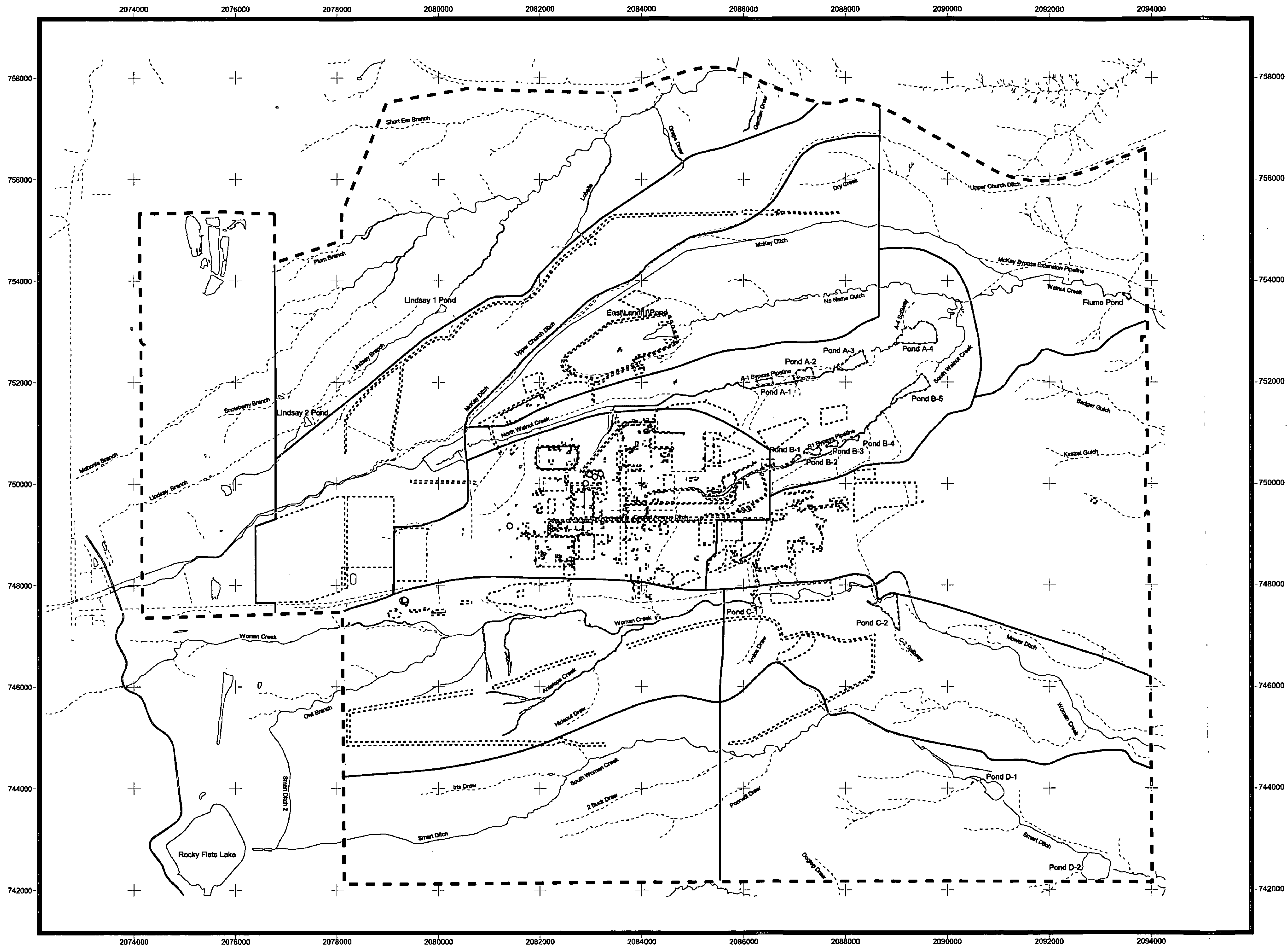


**Figure A3.4.7**

**2,3,7,8-TCDD TEQ (Mammal) Concentrations in Sitewide Surface Soil (Non-PMJM)**

## KEY

- O Concentration > 3x ESL
- O Concentration > ESL and <= 3x ESL
- O Concentration <= ESL
- O Nondetect (ND)

Min. Non-PMJM ESL = 0.004 ug/kg
3 x Min. Non-PMJM ESL = 0.012 ug/kg

**Standard Map Features**

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Ephemeral stream
- Intermittent stream
- Perennial stream
- Site boundary

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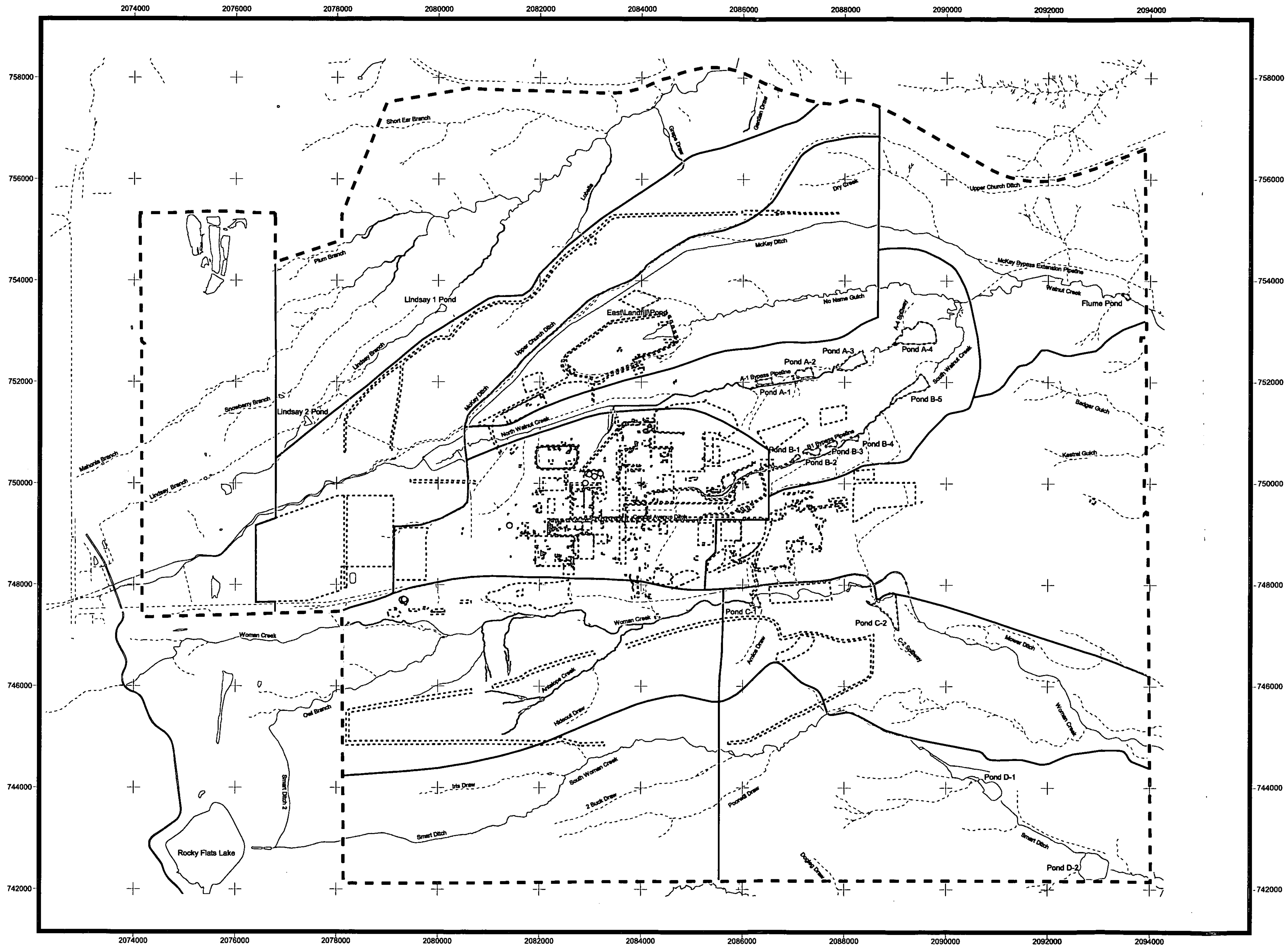


# Figure A3.4.8

## 2,3,7,8-TCDD TEQ (Bird) Concentrations in Sitewide Surface Soil (Non-PMJM)

## KEY

- O Concentration > 3x ESL
- O Concentration > ESL and <= 3x ESL
- O Concentration <= ESL
- O Nondetect (ND)

Min. Non-PMJM ESL = 0.013 ug/kg
3 x Min. Non-PMJM ESL = 0.039 ug/kg

### Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Ephemeral stream
- Intermittent stream
- Perennial stream
- Site boundary

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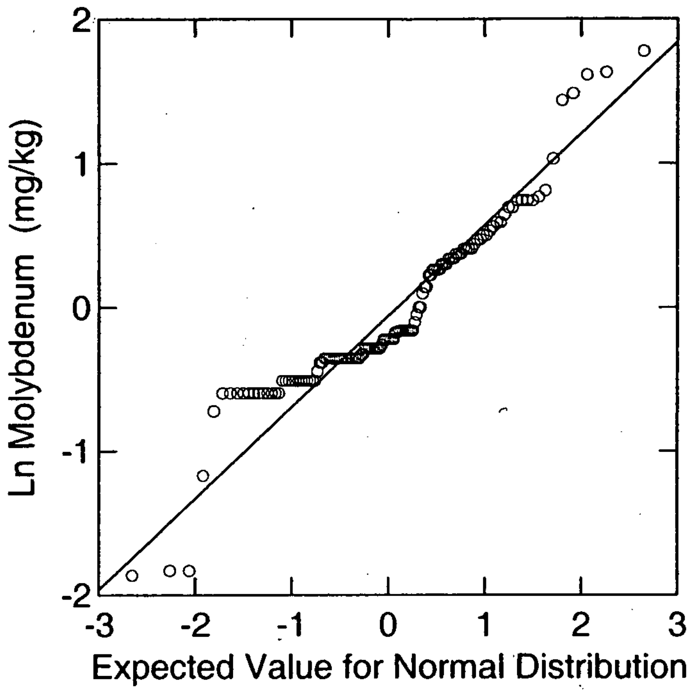
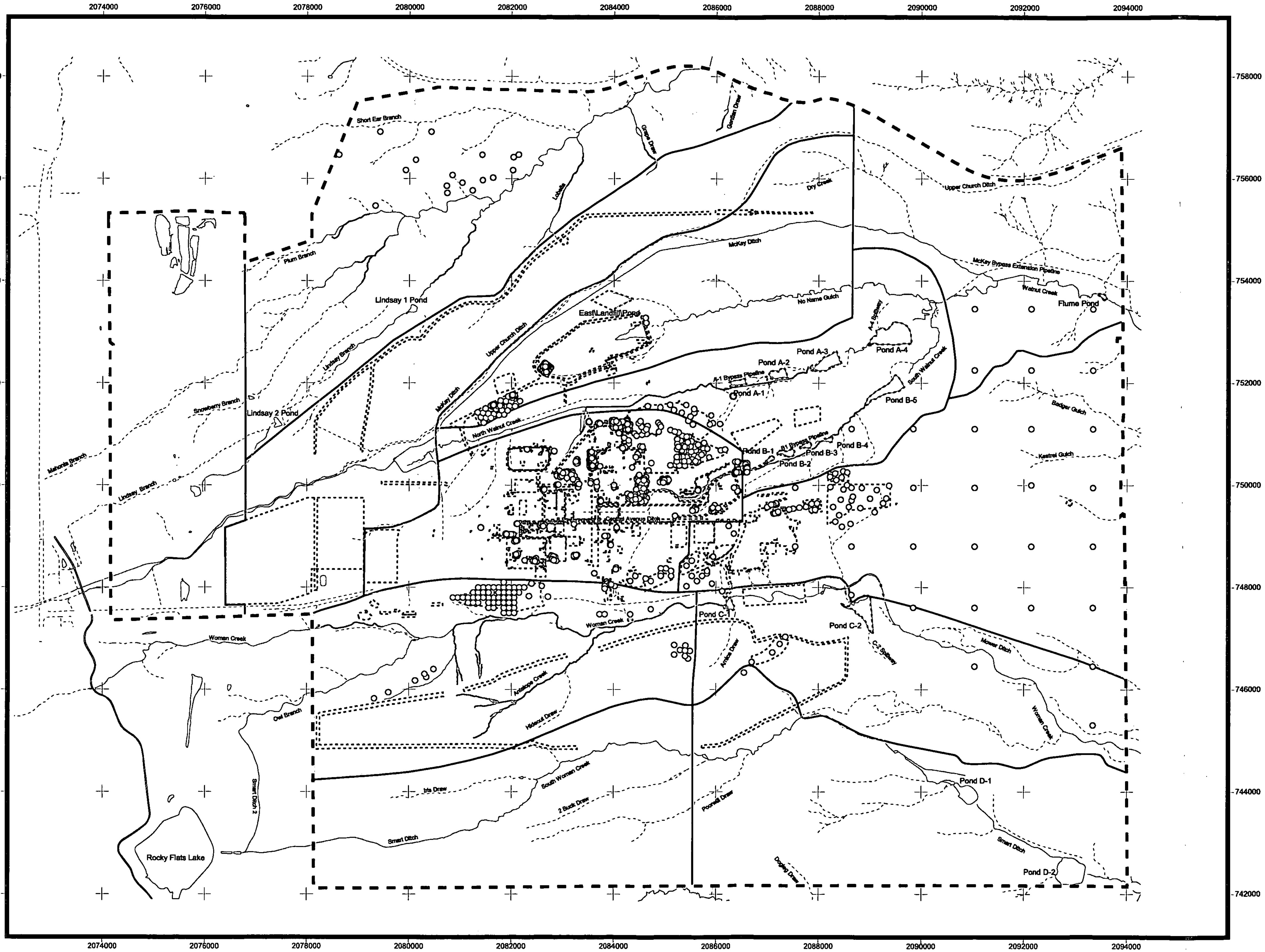



**Figure A3.4.9** **Probability Plot for Molybdenum (Natural Logarithm) in UWOEU Surface Soil**




# Figure A3.4.10

## Total PCB Concentrations in Sitewide Surface Soil (Non-PMJM)

## KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 42.3 ug/kg
3x Min. Non-PMJM ESL = 127 ug/kg

### Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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Scale 1:24,000

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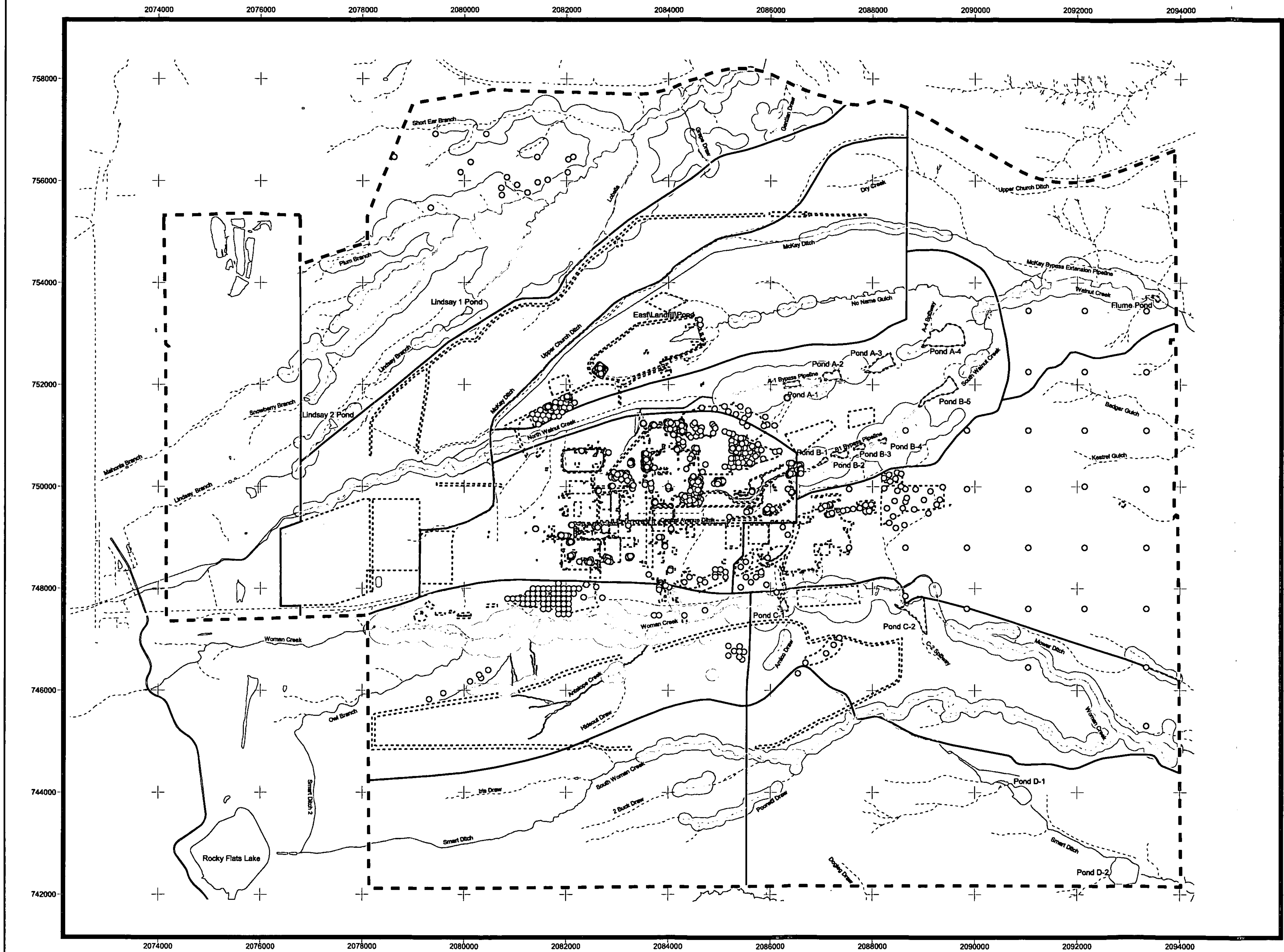
# Figure A3.4.11

## Total PCB Concentrations in Sitewide Surface Soil (PMJM)




# KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

PMJM ESL = 1350 ug/kg
3x PMJM ESL = 4050 ug/kg

## Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- PMJM habitat patches
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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# COMPREHENSIVE RISK ASSESSMENT

## UPPER WOMAN DRAINAGE EXPOSURE UNIT

## VOLUME 10: ATTACHMENT 4

### Risk Assessment Calculations

# TABLE OF CONTENTS

# UPPER WOMAN DRAINAGE EXPOSURE UNIT

## 1.0 Human Health Risk Assessment Tables

Table A4.1.1

Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Worker using Tier 1 EPCs

| | | | Cancer Risk Calculations | | | | Non-Cancer Hazard Calculations | | |
|---|---|---|---|---|---|---|---|---|---|
| Exposure Route | Contaminant of Concern | Tier 1 EPC (mg/kg) | Intake/Exposure Concentration (mg/kg/day) | CSF (mg/kg/day)-1 | Cancer Risk | | Intake/Exposure Concentration (mg/kg/day) | RfD (mg/kg/day) | Hazard Quotient |
| Surface Soil/Surface Sediment | | | | | | | | | |
| Ingestion | Benzo(a)pyrene | 2.25 | 5.41E-07 | 7.30 | 3.95E-06 | | 2.02E-06 | N/A | NC |
| | 2,3,7,8-TCDD TEQ | 5.46E-05 | 1.31E-11 | 1.50E05 | 1.97E-06 | | 4.92E-11 | N/A | NC |
| | | | | Ingestion Total: | 5.92E-06 | | | Ingestion Total: | NC |
| | | | | | | | | | |
| Inhalation - (indoor + outdoor) | Benzo(a)pyrene | 2.25 | 3.20E-09 | 0.310 | 9.93E-10 | | 1.20E-08 | N/A | NC |
| | 2,3,7,8-TCDD TEQ | 5.46E-05 | 7.78E-14 | 1.50E05 | 1.17E-08 | | 2.91E-13 | N/A | NC |
| | | | | Inhalation Total: | 1.27E-08 | | | Inhalation Total: | NC |
| | | | | | | | | | |
| Dermal | Benzo(a)pyrene | 2.25 | 2.71E-07 | 7.30 | 1.98E-06 | | 1.02E-06 | N/A | NC |
| | 2,3,7,8-TCDD TEQ | 5.46E-05 | 1.52E-12 | 1.50E05 | 2.28E-07 | | 5.70E-12 | N/A | NC |
| | | | | Dermal Total: | 2.21E-06 | | | Dermal Total: | 0 |
| | | | | Surface Soil/Surface Sediment Total: | 8.14E-06 | | | Surface Soil/Surface Sediment Total: | NC |
| | | | | | | | | | |
| | | | | WRW Total: | 8E-06 | | | WRW Total: | NC |

N/A = Not applicable or not available.

NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

**Table A4.1.2**

**Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Worker using Tier 2 EPCs**

| | | | Cancer Risk Calculations | | | Non-Cancer Hazard Calculations | | |
|---|---|---|---|---|---|---|---|---|
| **Exposure Route** | **Contaminant of Concern** | **Tier 2 EPC (mg/kg)** | **Intake/Exposure Concentration (mg/kg/day)** | **CSF $(mg/kg/day)^{-1}$** | **Cancer Risk** | **Intake/Exposure Concentration (mg/kg/day)** | **RfD (mg/kg/day)** | **Hazard Quotient** |
| **Surface Soil/Surface Sediment** | | | | | | | | |
| Ingestion | Benzo(a)pyrene | 0.343 | 8.24E-08 | 7.30 | 6.01E-07 | 3.08E-07 | N/A | NC |
| | 2,3,7,8-TCDD TEQ | 5.46E-05 | 1.31E-11 | 1.50E05 | 1.97E-06 | 4.92E-11 | N/A | NC |
| | | | | **Ingestion Total:** | **2.57E-06** | | **Ingestion Total:** | **NC** |
| | | | | | | | | |
| Inhalation - (indoor + outdoor) | Benzo(a)pyrene | 0.343 | 4.88E-10 | 0.310 | 1.51E-10 | 1.83E-09 | N/A | NC |
| | 2,3,7,8-TCDD TEQ | 5.46E-05 | 7.78E-14 | 1.50E05 | 1.17E-08 | 2.91E-13 | N/A | NC |
| | | | | **Inhalation Total:** | **1.18E-08** | | **Inhalation Total:** | **NC** |
| | | | | | | | | |
| Dermal | Benzo(a)pyrene | 0.343 | 4.13E-08 | 7.30 | 3.02E-07 | 1.55E-07 | N/A | NC |
| | 2,3,7,8-TCDD TEQ | 5.46E-05 | 1.52E-12 | 1.50E05 | 2.28E-07 | 5.70E-12 | N/A | NC |
| | | | | **Dermal Total:** | **5.30E-07** | | **Dermal Total:** | **NC** |
| | | | | **Surface Soil/Surface Sediment Total:** | **3.11E-06** | | **Surface Soil/Surface Sediment Total:** | **NC** |
| | | | | | | | | |
| | | | | **WRW Total:** | **3E-06** | | **WRW Total:** | **NC** |

N/A = Not applicable or not available.

NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

**Table A4.1.3**

**Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Visitor using Tier 1 EPCs**

| Exposure Route | Contaminant of Concern | Tier 1 EPC (mg/kg) | Cancer Risk Calculations | | | | Non-Cancer Hazard Calculations | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Intake/Exposure Concentration (mg/kg/day) | CSF (mg/kg/day)⁻¹ | Cancer Risk | | Intake/Exposure Concentration (mg/kg/day) | RfD (mg/kg/day) | Hazard Quotient |
| **Surface Soil/Surface Sediment** | | | | | | | | | |
| Ingestion | Benzo(a)pyrene | 2.25 | 5.03E-07 | 7.30 | 3.67E-06 | | 1.17E-06 | N/A | NC |
| | 2,3,7,8-TCDD TEQ | 5.46E-05 | 1.22E-11 | 1.50E05 | 1.83E-06 | | 2.85E-11 | N/A | NC |
| | | | | **Ingestion Total:** | **5.51E-06** | | | **Ingestion Total:** | **NC** |
| | | | | | | | | | |
| Inhalation - | Benzo(a)pyrene | 2.25 | 2.16E-09 | 0.310 | 6.69E-10 | | 5.03E-09 | N/A | NC |
| (outdoor) | 2,3,7,8-TCDD TEQ | 5.46E-05 | 5.24E-14 | 1.50E05 | 7.86E-09 | | 1.22E-13 | N/A | NC |
| | | | | **Inhalation Total:** | **8.53E-09** | | | **Inhalation Total:** | **NC** |
| | | | | | | | | | |
| Dermal | Benzo(a)pyrene | 2.25 | 4.13E-07 | 7.30 | 3.02E-06 | | 9.64E-07 | N/A | NC |
| | 2,3,7,8-TCDD TEQ | 5.46E-05 | 2.32E-12 | 1.50E05 | 3.47E-07 | | 5.40E-12 | N/A | NC |
| | | | | **Dermal Total:** | **3.36E-06** | | | **Dermal Total:** | **NC** |
| | | | **Surface Soil/Surface Sediment Total:** | | **8.88E-06** | | **Surface Soil/Surface Sediment Total:** | | **NC** |
| | | | | | | | | | |
| | | | | **WRV Total:** | **9E-06** | | | **WRV Total:** | **NC** |

N/A = Not applicable or not available.

NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

## Table A4.1.4

### Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Visitor using Tier 2 EPCs

| Exposure Route | Contaminant of Concern | Tier 2 EPC (mg/kg) | Cancer Risk Calculations | | | | Non-Cancer Hazard Calculations | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Intake/Exposure Concentration (mg/kg/day) | CSF (mg/kg/day)⁻¹ | Cancer Risk | | Intake/Exposure Concentration (mg/kg/day) | RfD (mg/kg/day) | Hazard Quotient |
| **Surface Soil/Surface Sediment** | | | | | | | | | |
| Ingestion | Benzo(a)pyrene | 0.343 | 7.66E-08 | 7.30 | 5.59E-07 | | 1.79E-07 | N/A | NC |
| | 2,3,7,8-TCDD TEQ | 0.000 | 1.22E-11 | 1.50E05 | 1.83E-06 | | 2.85E-11 | N/A | NC |
| | | | | **Ingestion Total:** | **2.39E-06** | | | **Ingestion Total:** | **NC** |
| | | | | | | | | | |
| Inhalation - (outdoor) | Benzo(a)pyrene | 0.343 | 3.28E-10 | 0.310 | 1.02E-10 | | 7.66E-10 | N/A | NC |
| | 2,3,7,8-TCDD TEQ | 0.000 | 5.24E-14 | 1.50E05 | 7.86E-09 | | 1.22E-13 | N/A | NC |
| | | | | **Inhalation Total:** | **7.96E-09** | | | **Inhalation Total:** | **NC** |
| | | | | | | | | | |
| Dermal | Benzo(a)pyrene | 0.343 | 6.29E-08 | 7.30 | 4.59E-07 | | 1.47E-07 | N/A | NC |
| | 2,3,7,8-TCDD TEQ | 0.000 | 2.32E-12 | 1.50E05 | 3.47E-07 | | 5.40E-12 | N/A | NC |
| | | | | **Dermal Total:** | **8.07E-07** | | | **Dermal Total:** | **NC** |
| | | | | **Surface Soil/Surface Sediment Total:** | **3.21E-06** | | | **Surface Soil/Surface Sediment Total:** | **NC** |
| | | | | | | | | | |
| | | | | **WRV Total:** | **3E-06** | | | **WRV Total:** | **NC** |

N/A = Not applicable or not available.

NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

# UPPER WOMAN DRAINAGE EXPOSURE UNIT

## 2.0 Ecological Risk Assessment Tables

**Table A4.2.1**
**Non-PMJM Intake Estimates for Antimony**
**Default Exposure Scenario**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Bioaccumulation Factors** | | | | | | |
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| lnCp = -3.233 + 0.938(lnCs) | 1 | BAFsm = ((0.5*BAFsp)+(0.5*BAFsi))*0.003*50) | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** | |
| 7.35 | Tier 1 95th UTL | 0.26 | 7.4 | 0.57 | 0.025 | |
| 7.86 | Tier 1 95th UCL | 0.27 | 7.9 | 0.61 | 0.009 | |
| 6.74 | Tier 2 95th UTL | 0.24 | 6.7 | 0.52 | 0.025 | |
| 4.67 | Tier 2 95th UCL | 0.17 | 4.7 | 0.36 | 0.009 | |
| **Intake Parameters** | | | | | | |
| | **$IR_{(food)}$ (kg/kg BW day)** | **$IR_{(water)}$ (kg/kg BW day)** | **$IR_{(soil)}$ (kg/kg BW day)** | **$P_{plant}$** | **$P_{invert}$** | **$P_{mammal}$** |
| Deer Mouse - Insectivore | 0.065 | 0.19 | 0.001 | 0 | 1 | 0 |
| Coyote - Insectivore | 0.015 | 0.08 | 0.0004 | 0 | 1 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Deer Mouse - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 4.78E-01 | NA | 9.56E-03 | 4.75E-03 | 4.92E-01 |
| Tier 1 95th UCL | NA | 5.11E-01 | NA | 1.02E-02 | 1.71E-03 | 5.23E-01 |
| Tier 2 95th UTL | NA | 4.38E-01 | NA | 8.76E-03 | 4.75E-03 | 4.52E-01 |
| Tier 2 95th UCL | NA | 3.04E-01 | NA | 6.07E-03 | 1.71E-03 | 3.11E-01 |
| *Coyote - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 1.10E-01 | NA | 3.09E-03 | 2.00E-03 | 1.15E-01 |
| Tier 1 95th UCL | NA | 1.18E-01 | NA | 3.30E-03 | 7.20E-04 | 1.22E-01 |
| Tier 2 95th UTL | NA | 1.01E-01 | NA | 2.83E-03 | 2.00E-03 | 1.06E-01 |
| Tier 2 95th UCL | NA | 7.01E-02 | NA | 1.96E-03 | 7.20E-04 | 7.27E-02 |

NA = Not applicable.

**Table A4.2.2**
**PMJM Intake Estimates for Antimony**
**Default Exposure Scenario**

| | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| lnCp = -3.233 + 0.938(lnCs) | 1 | BAFsm = ((0.5*BAFsp)+(0.5*BAFsi))*0.003*50 | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Patch** | **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** |
| 19 | 8.8 | MDC | 0.30 | 8.8 | 0.68 | 0.08 |
| 19 | 8.8 | 95th UTL | N/A | N/A | N/A | 0.025 |
| 19 | 6.61 | 95th UCL | 0.23 | 6.6 | 0.51 | 0.009 |
| 19 | 4.77 | Mean | 0.17 | 4.8 | 0.37 | 0.007 |
| 20 | 49.8 | MDC | 1.54 | 49.8 | 3.85 | 0.08 |
| 20 | 46.43 | 95th UTL | 1.44 | 46.4 | 3.59 | 0.025 |
| 20 | 18.9 | 95th UCL | 0.62 | 18.9 | 1.46 | 0.009 |
| 20 | 10.55 | Mean | 0.36 | 10.6 | 0.82 | 0.007 |
| 21 | 6.5 | MDC | 0.23 | 6.5 | 0.50 | 0.08 |
| 21 | 6.5 | 95th UTL | N/A | N/A | N/A | 0.025 |
| 21 | 5.8 | 95th UCL | 0.21 | 5.8 | 0.45 | 0.009 |
| 21 | 4.38 | Mean | 0.16 | 4.4 | 0.34 | 0.007 |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| PMJM | 0.17 | 0.15 | 0.004 | 0.7 | 0.3 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Patch 19* | | | | | | |
| MDC | 3.61E-02 | 4.49E-01 | N/A | 3.59E-02 | 1.20E-02 | 5.33E-01 |
| 95th UTL | N/A | N/A | N/A | 3.59E-02 | 3.75E-03 | 3.97E-02 |
| 95th UCL | 2.76E-02 | 3.37E-01 | N/A | 2.70E-02 | 1.35E-03 | 3.93E-01 |
| Mean | 2.03E-02 | 2.43E-01 | N/A | 1.95E-02 | 1.05E-03 | 2.84E-01 |
| *Patch 20* | | | | | | |
| MDC | 1.83E-01 | 2.54E+00 | N/A | 2.03E-01 | 1.20E-02 | 2.94E+00 |
| 95th UTL | 1.72E-01 | 2.37E+00 | N/A | 1.89E-01 | 3.75E-03 | 2.73E+00 |
| 95th UCL | 7.39E-02 | 9.64E-01 | N/A | 7.71E-02 | 1.35E-03 | 1.12E+00 |
| Mean | 4.28E-02 | 5.38E-01 | N/A | 4.30E-02 | 1.05E-03 | 6.25E-01 |
| *Patch 21* | | | | | | |
| MDC | 2.72E-02 | 3.32E-01 | N/A | 2.65E-02 | 1.20E-02 | 3.97E-01 |
| 95th UTL | N/A | N/A | N/A | 2.65E-02 | 3.75E-03 | 3.03E-02 |
| 95th UCL | 2.44E-02 | 2.96E-01 | N/A | 2.37E-02 | 1.35E-03 | 3.45E-01 |
| Mean | 1.88E-02 | 2.23E-01 | N/A | 1.79E-02 | 1.05E-03 | 2.61E-01 |

NA = Not applicable or not available.

## Table A4.2.3
## Terrestrial Plant Hazard Quotients for Antimony

| EPC Statistic | Concentration (mg/kg) | TRV (mg/kg) Screening ESL | Hazard Quotients Screening ESL |
|---|---|---|---|
| *Terrestrial Plant* | | | |
| Tier 1 95th UTL | 7.35 | 5.00E+00 | 1 |
| Tier 1 95th UCL | 7.86 | 5.00E+00 | **2** |
| Tier 2 95th UTL | 6.74 | 5.00E+00 | 1 |
| Tier 2 95th UCL | 4.67 | 5.00E+00 | 0.9 |

No alternative TRVs were available for antimony.
**Bold = Hazard quotients>1.**

## Table A4.2.4
## Non-PMJM Hazard Quotients for Antimony

| | | TRV (mg/kg BW day) | | | Hazard Quotients | | |
|---|---|---|---|---|---|---|---|
| | Total Intake (mg/kg BW day) | NOAEL | LOAEL | Geometric Mean NOAEL | NOAEL | LOAEL | Geometric Mean NOAEL |
| **Antimony (Default Exposure)** | | | | | | | |
| *Deer Mouse - Insectivore* | | | | | | | |
| Tier 1 95th UTL | 4.92E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **8** | 0.8 | 0.04 |
| Tier 1 95th UCL | 5.23E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **9** | 0.9 | 0.04 |
| Tier 2 95th UTL | 4.52E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **8** | 0.8 | 0.03 |
| Tier 2 95th UCL | 3.11E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **5** | 0.5 | 0.02 |
| *Coyote - Insectivore* | | | | | | | |
| Tier 1 95th UTL | 1.15E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **2** | 0.2 | 0.01 |
| Tier 1 95th UCL | 1.22E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **2** | 0.2 | 0.01 |
| Tier 2 95th UTL | 1.06E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **2** | 0.2 | 0.01 |
| Tier 2 95th UCL | 7.27E-02 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **1** | 0.1 | 0.01 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

# Table A4.2.5
## PMJM Hazard Quotients for Antimony

| Patch/ EPC Statistic | Total Intake (mg/kg BW day) | TRV (mg/kg BW day) NOAEL | LOAEL | Geometric Mean NOAEL | Hazard Quotients NOAEL | LOAEL | Sample et al. (1996) NOAEL |
|---|---|---|---|---|---|---|---|
| **Antimony (Default Exposure)** | | | | | | | |
| *Patch 19* | | | | | | | |
| MDC | 5.33E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **9** | 0.9 | 0.0 |
| 95th UTL | 3.97E-02 | 6.00E-02 | 5.90E-01 | 1.33E+01 | 1 | 0.1 | 0.0 |
| 95th UCL | 3.93E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **7** | 0.7 | 0.0 |
| Mean | 2.84E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **5** | 0.5 | 0.02 |
| *Patch 20* | | | | | | | |
| MDC | 2.94E+00 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **49** | **5** | 0.2 |
| 95th UTL | 2.73E+00 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **46** | **5** | 0.2 |
| 95th UCL | 1.12E+00 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **19** | **2** | 0.1 |
| Mean | 6.25E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **10** | 1 | 0.05 |
| *Patch 21* | | | | | | | |
| MDC | 3.97E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **7** | 0.7 | 0.0 |
| 95th UTL | 3.03E-02 | 6.00E-02 | 5.90E-01 | 1.33E+01 | 1 | 0.1 | 0.0 |
| 95th UCL | 3.45E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **6** | 0.6 | 0.0 |
| Mean | 2.61E-01 | 6.00E-02 | 5.90E-01 | 1.33E+01 | **4** | 0.4 | 0.0 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

# Table A4.2.6
## PMJM Intake Estimates for Chromium
## Default Exposure Scenario

| | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.084 | 3.162 | lnCm = -1.495 + 0.7326(lnCs) | | | | |
| Media Concentrations (mg/kg) | | | | | | |
| Patch | Soil Concentration | Statistic | Plant | Earthworm | Small Mammal | Surface Water (mg/L) |
| 19 | 26 | MDC | 2.18 | 82.2 | 2.44 | 0.348 |
| 19 | 26 | 95th UTL | 2.18 | 82.2 | 2.44 | 0.024 |
| 19 | 20.3 | 95th UCL | 1.71 | 64.2 | 2.04 | 0.008 |
| 19 | 17.18 | Mean | 1.44 | 54.3 | 1.80 | 0.01 |
| 20 | 24.2 | MDC | 2.03 | 76.5 | 2.31 | 0.348 |
| 20 | 24.17 | 95th UTL | 2.03 | 76.4 | 2.31 | 0.024 |
| 20 | 16.37 | 95th UCL | 1.38 | 51.8 | 1.74 | 0.008 |
| 20 | 14.29 | Mean | 1.20 | 45.2 | 1.57 | 0.01 |
| 21 | 23.3 | MDC | 1.96 | 73.7 | 2.25 | 0.348 |
| 21 | 23.3 | 95th UTL | 1.96 | 73.7 | 2.25 | 0.024 |
| 21 | 18.98 | 95th UCL | 1.59 | 60.0 | 1.94 | 0.008 |
| 21 | 14.03 | Mean | 1.18 | 44.4 | 1.55 | 0.01 |
| Intake Parameters | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| PMJM | 0.17 | 0.15 | 0.004 | 0.7 | 0.3 | 0 |
| Intake Estimates (mg/kg BW day) | | | | | | |
| | Plant Tissue | Invertebrate Tissue | Mammal Tissue | Soil | Surface Water | Total |
| *Patch 19* | | | | | | |
| MDC | 2.60E-01 | 4.19E+00 | N/A | 1.06E-01 | 5.22E-02 | 4.61E+00 |
| 95th UTL | 2.60E-01 | 4.19E+00 | N/A | 1.06E-01 | 3.60E-03 | 4.56E+00 |
| 95th UCL | 2.03E-01 | 3.27E+00 | N/A | 8.28E-02 | 1.20E-03 | 3.56E+00 |
| Mean | 1.72E-01 | 2.77E+00 | N/A | 7.01E-02 | 1.50E-03 | 3.01E+00 |
| *Patch 20* | | | | | | |
| MDC | 2.42E-01 | 3.90E+00 | N/A | 9.87E-02 | 5.22E-02 | 4.30E+00 |
| 95th UTL | 2.42E-01 | 3.90E+00 | N/A | 9.86E-02 | 3.60E-03 | 4.24E+00 |
| 95th UCL | 1.64E-01 | 2.64E+00 | N/A | 6.68E-02 | 1.20E-03 | 2.87E+00 |
| Mean | 1.43E-01 | 2.30E+00 | N/A | 5.83E-02 | 1.50E-03 | 2.51E+00 |
| *Patch 21* | | | | | | |
| MDC | 2.33E-01 | 3.76E+00 | N/A | 9.51E-02 | 5.22E-02 | 4.14E+00 |
| 95th UTL | 2.33E-01 | 3.76E+00 | N/A | 9.51E-02 | 3.60E-03 | 4.09E+00 |
| 95th UCL | 1.90E-01 | 3.06E+00 | N/A | 7.74E-02 | 1.20E-03 | 3.33E+00 |
| Mean | 1.40E-01 | 2.26E+00 | N/A | 5.72E-02 | 1.50E-03 | 2.46E+00 |

NA = Not applicable or not available.

## Table A4.2.7
## PMJM Hazard Quotients for Chromium

| Patch/ EPC Statistic | Total Intake (mg/kg BW day) | TRV (mg/kg BW day) Chromium VI NOAEL | Chromium VI LOAEL | Chromium III NOAEL | Chromium III LOAEL | Hazard Quotients Chromium VI NOAEL | Chromium VI LOAEL | Chromium III NOAEL | Chromium III LOAEL |
|---|---|---|---|---|---|---|---|---|---|
| **Chromium (Default Exposure)** | | | | | | | | | |
| *Patch 19* | | | | | | | | | |
| MDC | 4.61E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 1 | 0.4 | 0.002 | N/A |
| 95th UTL | 4.56E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 1 | 0.3 | 0.002 | N/A |
| 95th UCL | 3.56E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 1 | 0.3 | 0.001 | N/A |
| Mean | 3.01E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 0.9 | 0.2 | 0.001 | N/A |
| *Patch 20* | | | | | | | | | |
| MDC | 4.30E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 1 | 0.3 | 0.002 | N/A |
| 95th UTL | 4.24E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 1 | 0.3 | 0.002 | N/A |
| 95th UCL | 2.87E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 0.9 | 0.2 | 0.001 | N/A |
| Mean | 2.51E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 0.8 | 0.2 | 0.001 | N/A |
| *Patch 21* | | | | | | | | | |
| MDC | 4.14E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 1 | 0.3 | 0.002 | N/A |
| 95th UTL | 4.09E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 1 | 0.3 | 0.001 | N/A |
| 95th UCL | 3.33E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 1 | 0.3 | 0.001 | N/A |
| Mean | 2.46E+00 | 3.28E+00 | 1.31E+01 | 2.74E+03 | N/A | 0.8 | 0.2 | 0.001 | N/A |

NA = Not applicable.

**Bold = Hazard quotients>1.**

**Table A4.2.8**
**Non-PMJM Intake Estimates for Copper**
**Default Exposure Scenario**

| Bioaccumulation Factors | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| lnCp = 0.669 + 0.394(lnCs) | lnCi = 1.675 + 0.264(lnCs) | lnCsm = 2.042 + .1444(lnCs) | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** | |
| 68.3 | Tier 1 95th UTL | 10.31 | 16.28 | 14.18 | 0.046 | |
| 38.5 | Tier 1 95th UCL | 8.23 | 14.00 | 13.05 | 0.016 | |
| 16.8 | Tier 2 95th UTL | 5.93 | 11.24 | 11.58 | 0.046 | |
| 15 | Tier 2 95th UCL | 5.67 | 10.91 | 11.39 | 0.016 | |
| **Intake Parameters** | | | | | | |
| | **$IR_{(food)}$ (kg/kg BW day)** | **$IR_{(water)}$ (kg/kg BW day)** | **$IR_{(soil)}$ (kg/kg BW day)** | **$P_{plant}$** | **$P_{invert}$** | **$P_{mammal}$** |
| Mourning Dove - Herbivore | 0.23 | 0.12 | 0.021 | 1 | 0 | 0 |
| Mourning Dove - Insectivore | 0.23 | 0.12 | 0.021 | 0 | 1 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Mourning Dove - Herbivore* | | | | | | |
| Tier 1 95th UTL | 2.37E+00 | NA | NA | 1.46E+00 | 5.52E-03 | 3.84E+00 |
| Tier 1 95th UCL | 1.89E+00 | NA | NA | 8.24E-01 | 1.92E-03 | 2.72E+00 |
| Tier 2 95th UTL | 1.36E+00 | NA | NA | 3.59E-01 | 5.52E-03 | 1.73E+00 |
| Tier 2 95th UCL | 1.31E+00 | NA | NA | 3.21E-01 | 1.92E-03 | 1.63E+00 |
| *Mourning Dove - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 3.75E+00 | NA | 1.46E+00 | 5.52E-03 | 5.21E+00 |
| Tier 1 95th UCL | NA | 3.22E+00 | NA | 8.24E-01 | 1.92E-03 | 4.04E+00 |
| Tier 2 95th UTL | NA | 2.59E+00 | NA | 3.59E-01 | 5.52E-03 | 2.95E+00 |
| Tier 2 95th UCL | NA | 2.51E+00 | NA | 3.21E-01 | 1.92E-03 | 2.83E+00 |

NA = Not applicable.

## Table A4.2.9
## PMJM Intake Estimates for Copper
## Default Exposure Scenario

| | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| lnCp = 0.669 + 0.394(lnCs) | lnCi = 1.675 + 0.264(lnCs) | lnCsm = 2.042 + .1444(lnCs) | | | | |
| Media Concentrations (mg/kg) | | | | | | |
| Patch | Soil Concentration | Statistic | Plant | Earthworm | Small Mammal | Surface Water (mg/L) |
| 20 | 112 | MDC | 12.53 | 18.55 | 15.23 | 0.259 |
| 20 | 93.54 | 95th UTL | 11.67 | 17.69 | 14.84 | 0.046 |
| 20 | 45.35 | 95th UCL | 8.77 | 14.61 | 13.37 | 0.016 |
| 20 | 32.48 | Mean | 7.69 | 13.38 | 12.74 | 0.013 |
| Intake Parameters | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| PMJM | 0.17 | 0.15 | 0.004 | 0.7 | 0.3 | 0 |
| Intake Estimates (mg/kg BW day) | | | | | | |
| | Plant Tissue | Invertebrate Tissue | Mammal Tissue | Soil | Surface Water | Total |
| *Patch 20* | | | | | | |
| MDC | 1.49E+00 | 9.46E-01 | N/A | 4.57E-01 | 3.89E-02 | 2.93E+00 |
| 95th UTL | 1.39E+00 | 9.02E-01 | N/A | 3.82E-01 | 6.90E-03 | 2.68E+00 |
| 95th UCL | 1.04E+00 | 7.45E-01 | N/A | 1.85E-01 | 2.40E-03 | 1.98E+00 |
| Mean | 9.16E-01 | 6.82E-01 | N/A | 1.33E-01 | 1.95E-03 | 1.73E+00 |

NA = Not applicable or not available.

## Table A4.2.10
## Non-PMJM Hazard Quotients for Copper

| | Total Intake (mg/kg BW day) | TRV (mg/kg BW day) NOAEL | Threshold | LOAEL | Hazard Quotients NOAEL | Threshold | LOAEL |
|---|---|---|---|---|---|---|---|
| **Copper (Default Exposure)** | | | | | | | |
| *Mourning Dove - Herbivore* | | | | | | | |
| Tier 1 95th UTL | 3.84E+00 | 2.30E+00 | 1.10E+01 | 5.23E+01 | **2** | 0.3 | 0.1 |
| Tier 1 95th UCL | 2.72E+00 | 2.30E+00 | 1.10E+01 | 5.23E+01 | 1 | 0.2 | 0.1 |
| Tier 2 95th UTL | 1.73E+00 | 2.30E+00 | 1.10E+01 | 5.23E+01 | 0.8 | 0.2 | 0.03 |
| Tier 2 95th UCL | 1.63E+00 | 2.30E+00 | 1.10E+01 | 5.23E+01 | 0.7 | 0.1 | 0.03 |
| *Mourning Dove - Insectivore* | | | | | | | |
| Tier 1 95th UTL | 5.21E+00 | 2.30E+00 | 1.10E+01 | 5.23E+01 | **2** | 0.5 | 0.1 |
| Tier 1 95th UCL | 4.04E+00 | 2.30E+00 | 1.10E+01 | 5.23E+01 | **2** | 0.4 | 0.1 |
| Tier 2 95th UTL | 2.95E+00 | 2.30E+00 | 1.10E+01 | 5.23E+01 | 1 | 0.3 | 0.1 |
| Tier 2 95th UCL | 2.83E+00 | 2.30E+00 | 1.10E+01 | 5.23E+01 | 1 | 0.3 | 0.1 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

## Table A4.2.11

## PMJM Hazard Quotients for Copper

| Patch/ EPC Statistic | Total Intake (mg/kg BW-day) | TRV (mg/kg BW/day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | | NOAEL | LOAEL | NOAEL | LOAEL |
| **Copper (Default Exposure)** | | | | | |
| *Patch 20* | | | | | |
| MDC | 2.93E+00 | 2.67E+00 | 6.32E+02 | 1 | 0.005 |
| 95th UTL | 2.68E+00 | 2.67E+00 | 6.32E+02 | 1 | 0.004 |
| 95th UCL | 1.98E+00 | 2.67E+00 | 6.32E+02 | 0.7 | 0.003 |
| Mean | 1.73E+00 | 2.67E+00 | 6.32E+02 | 0.6 | 0.003 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

## Table A4.2.12
## PMJM Intake Estimates for Manganese
## Default Exposure Scenario

| | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.234 | lnCi = 0.809 + 0.682(lnCs) | 0.037 | | | | |
| Media Concentrations (mg/kg) | | | | | | |
| **Patch** | **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** |
| 19 | 555 | MDC | 129.87 | 167.1 | 20.54 | 7.77 |
| 19 | 555 | 95th UTL | 129.87 | 167.1 | 20.54 | 0.665 |
| 19 | 399.94 | 95th UCL | 93.59 | 133.6 | 14.80 | 0.188 |
| 19 | 334.7 | Mean | 78.32 | 118.3 | 12.38 | 0.209 |
| 20 | 829 | MDC | 193.99 | 219.7 | 30.67 | 7.77 |
| 20 | 617.48 | 95th UTL | 144.49 | 179.7 | 22.85 | 0.665 |
| 20 | 361.4 | 95th UCL | 84.57 | 124.7 | 13.37 | 0.188 |
| 20 | 293 | Mean | 68.56 | 108.1 | 10.84 | 0.209 |
| 21 | 476 | MDC | 111.38 | 150.5 | 17.61 | 7.77 |
| 21 | 476 | 95th UTL | 111.38 | 150.5 | 17.61 | 0.665 |
| 21 | 448.21 | 95th UCL | 104.88 | 144.4 | 16.58 | 0.188 |
| 21 | 358.43 | Mean | 83.87 | 124.0 | 13.26 | 0.209 |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| PMJM | 0.17 | 0.15 | 0.004 | 0.7 | 0.3 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Patch 19* | | | | | | |
| MDC | 1.55E+01 | 8.52E+00 | N/A | 2.26E+00 | 1.17E+00 | 2.74E+01 |
| 95th UTL | 1.55E+01 | 8.52E+00 | N/A | 2.26E+00 | 9.98E-02 | 2.63E+01 |
| 95th UCL | 1.11E+01 | 6.82E+00 | N/A | 1.63E+00 | 2.82E-02 | 1.96E+01 |
| Mean | 9.32E+00 | 6.04E+00 | N/A | 1.37E+00 | 3.14E-02 | 1.68E+01 |
| *Patch 20* | | | | | | |
| MDC | 2.31E+01 | 1.12E+01 | N/A | 3.38E+00 | 1.17E+00 | 3.88E+01 |
| 95th UTL | 1.72E+01 | 9.16E+00 | N/A | 2.52E+00 | 9.98E-02 | 2.90E+01 |
| 95th UCL | 1.01E+01 | 6.36E+00 | N/A | 1.47E+00 | 2.82E-02 | 1.79E+01 |
| Mean | 8.16E+00 | 5.51E+00 | N/A | 1.20E+00 | 3.14E-02 | 1.49E+01 |
| *Patch 21* | | | | | | |
| MDC | 1.33E+01 | 7.67E+00 | N/A | 1.94E+00 | 1.17E+00 | 2.40E+01 |
| 95th UTL | 1.33E+01 | 7.67E+00 | N/A | 1.94E+00 | 9.98E-02 | 2.30E+01 |
| 95th UCL | 1.25E+01 | 7.37E+00 | N/A | 1.83E+00 | 2.82E-02 | 2.17E+01 |
| Mean | 9.98E+00 | 6.32E+00 | N/A | 1.46E+00 | 3.14E-02 | 1.78E+01 |

NA = Not applicable or not available.

# Table A4.2.13
## PMJM Hazard Quotients for Manganese

| Patch/ EPC Statistic | Total Intake (mg/kg BW-day) | TRV (mg/kg BW day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | | NOAEL | LOAEL | NOAEL | LOAEL |
| **Manganese (Default Exposure)** | | | | | |
| *Patch 19* | | | | | |
| MDC | 2.74E+01 | 1.33E+01 | 1.59E+02 | **2** | 0.2 |
| 95th UTL | 2.63E+01 | 1.33E+01 | 1.59E+02 | **2** | 0.2 |
| 95th UCL | 1.96E+01 | 1.33E+01 | 1.59E+02 | 1 | 0.1 |
| Mean | 1.68E+01 | 1.33E+01 | 1.59E+02 | 1 | 0.1 |
| *Patch 20* | | | | | |
| MDC | 3.88E+01 | 1.33E+01 | 1.59E+02 | **3** | 0.2 |
| 95th UTL | 2.90E+01 | 1.33E+01 | 1.59E+02 | **2** | 0.2 |
| 95th UCL | 1.79E+01 | 1.33E+01 | 1.59E+02 | 1 | 0.1 |
| Mean | 1.49E+01 | 1.33E+01 | 1.59E+02 | 1 | 0.1 |
| *Patch 21* | | | | | |
| MDC | 2.40E+01 | 1.33E+01 | 1.59E+02 | **2** | 0.2 |
| 95th UTL | 2.30E+01 | 1.33E+01 | 1.59E+02 | **2** | 0.1 |
| 95th UCL | 2.17E+01 | 1.33E+01 | 1.59E+02 | **2** | 0.1 |
| Mean | 1.78E+01 | 1.33E+01 | 1.59E+02 | 1 | 0.1 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

**Table A4.2.14**
**PMJM Intake Estimates for Molybdenum**
**Default Exposure Scenario**

| | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.25 | 2.09 | BAFsm = ((0.5*BAFsp)+(0.5*BAFsi))*0.003*50) | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Patch** | **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** |
| 20 | 4.4 | MDC | 1.10 | 9.20 | 9.01 | 0.028 |
| 20 | 3.05 | 95th UTL | 0.76 | 6.37 | 6.24 | 0.006 |
| 20 | 1.61 | 95th UCL | 0.40 | 3.36 | 3.30 | 0.003 |
| 20 | 1.22 | Mean | 0.31 | 2.55 | 2.50 | 0.003 |
| 21 | 2.25 | MDC | 0.56 | 4.70 | 4.61 | 0.028 |
| 21 | 2.25 | 95th UTL | 0.56 | 4.70 | N/A | 0.006 |
| 21 | 2.22 | 95th UCL | 0.56 | 4.64 | 4.55 | 0.003 |
| 21 | 1.84 | Mean | 0.46 | 3.85 | 3.77 | 0.003 |
| **Intake Parameters** | | | | | | |
| | **$IR_{(food)}$ (kg/kg BW day)** | **$IR_{(water)}$ (kg/kg BW day)** | **$IR_{(soil)}$ (kg/kg BW day)** | **$P_{plant}$** | **$P_{invert}$** | **$P_{mammal}$** |
| PMJM | 0.17 | 0.15 | 0.004 | 0.7 | 0.3 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Patch 20* | | | | | | |
| MDC | 1.31E-01 | 4.69E-01 | N/A | 1.80E-02 | 4.20E-03 | 6.22E-01 |
| 95th UTL | 9.07E-02 | 3.25E-01 | N/A | 1.24E-02 | 9.00E-04 | 4.29E-01 |
| 95th UCL | 4.79E-02 | 1.72E-01 | N/A | 6.57E-03 | 4.50E-04 | 2.27E-01 |
| Mean | 3.63E-02 | 1.30E-01 | N/A | 4.98E-03 | 4.50E-04 | 1.72E-01 |
| *Patch 21* | | | | | | |
| MDC | 6.69E-02 | 2.40E-01 | N/A | 9.18E-03 | 4.20E-03 | 3.20E-01 |
| 95th UTL | 6.69E-02 | 2.40E-01 | N/A | 9.18E-03 | 9.00E-04 | 3.17E-01 |
| 95th UCL | 6.60E-02 | 2.37E-01 | N/A | 9.06E-03 | 4.50E-04 | 3.12E-01 |
| Mean | 5.47E-02 | 1.96E-01 | N/A | 7.51E-03 | 4.50E-04 | 2.59E-01 |

NA = Not applicable or not available.

**Table A4.2.15**
**PMJM Hazard Quotients for Molybdenum**

| Patch/ EPC Statistic | Total Intake (mg/kg BW - day) | TRV (mg/kg BW day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | | NOAEL | LOAEL | NOAEL | LOAEL |
| Molybdenum (Default Exposure) | | | | | |
| *Patch 20* | | | | | |
| MDC | 6.22E-01 | 2.60E-01 | 2.60E+00 | **2** | 0.2 |
| 95th UTL | 4.29E-01 | 2.60E-01 | 2.60E+00 | **2** | 0.2 |
| 95th UCL | 2.27E-01 | 2.60E-01 | 2.60E+00 | 1 | 0.1 |
| Mean | 1.72E-01 | 2.60E-01 | 2.60E+00 | 1 | 0.1 |
| *Patch 21* | | | | | |
| MDC | 3.20E-01 | 2.60E-01 | 2.60E+00 | 1 | 0.1 |
| 95th UTL | 3.17E-01 | 2.60E-01 | 2.60E+00 | 1 | 0.1 |
| 95th UCL | 3.12E-01 | 2.60E-01 | 2.60E+00 | 1 | 0.1 |
| Mean | 2.59E-01 | 2.60E-01 | 2.60E+00 | 1 | 0.1 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

## Table A4.2.16
## Non-PMJM Intake Estimates for Nickel
## Default Exposure Scenario

| Bioaccumulation Factors | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| lnCp = -2.224+0.748(lnCs) | 4.73 | lnCm = -0.2462 + 0.4658(lnCs) | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** | |
| 21.1 | Tier 1 95th UTL | 1.06 | 99.8 | 3.24 | 0.021 | |
| 14 | Tier 1 95th UCL | 0.78 | 66.2 | 2.67 | 0.013 | |
| 13.3 | Tier 2 95th UTL | 0.75 | 62.9 | 2.61 | 0.021 | |
| 12.1 | Tier 2 95th UCL | 0.70 | 57.2 | 2.50 | 0.013 | |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| Mourning Dove - Insectivore | 0.23 | 0.12 | 0.021 | 0 | 1 | 0 |
| Deer Mouse - Herbivore | 0.111 | 0.19 | 0.002 | 1 | 0 | 0 |
| Deer Mouse - Insectivore | 0.065 | 0.19 | 0.001 | 0 | 1 | 0 |
| Coyote - Generalist | 0.015 | 0.08 | 0.001 | 0 | 0.25 | 0.75 |
| Coyote - Insectivore | 0.015 | 0.08 | 0.0004 | 0 | 1 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Mourning Dove - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 2.30E+01 | NA | 4.51E-01 | 2.52E-03 | 2.34E+01 |
| Tier 1 95th UCL | NA | 1.52E+01 | NA | 2.99E-01 | 1.56E-03 | 1.55E+01 |
| Tier 2 95th UTL | NA | 1.45E+01 | NA | 2.84E-01 | 2.52E-03 | 1.48E+01 |
| Tier 2 95th UCL | NA | 1.32E+01 | NA | 2.59E-01 | 1.56E-03 | 1.34E+01 |
| *Deer Mouse - Herbivore* | | | | | | |
| Tier 1 95th UTL | 1.17E-01 | NA | NA | 4.68E-02 | 3.99E-03 | 1.68E-01 |
| Tier 1 95th UCL | 8.64E-02 | NA | NA | 3.11E-02 | 2.47E-03 | 1.20E-01 |
| Tier 2 95th UTL | 8.32E-02 | NA | NA | 2.95E-02 | 3.99E-03 | 1.17E-01 |
| Tier 2 95th UCL | 7.75E-02 | NA | NA | 2.69E-02 | 2.47E-03 | 1.07E-01 |
| *Deer Mouse - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 6.49E+00 | NA | 2.74E-02 | 3.99E-03 | 6.52E+00 |
| Tier 1 95th UCL | NA | 4.30E+00 | NA | 1.82E-02 | 2.47E-03 | 4.32E+00 |
| Tier 2 95th UTL | NA | 4.09E+00 | NA | 1.73E-02 | 3.99E-03 | 4.11E+00 |
| Tier 2 95th UCL | NA | 3.72E+00 | NA | 1.57E-02 | 2.47E-03 | 3.74E+00 |
| *Coyote - Generalist* | | | | | | |
| Tier 1 95th UTL | NA | 3.74E-01 | 3.64E-02 | 1.58E-02 | 1.68E-03 | 4.28E-01 |
| Tier 1 95th UCL | NA | 2.48E-01 | 3.01E-02 | 1.05E-02 | 1.04E-03 | 2.90E-01 |
| Tier 2 95th UTL | NA | 2.36E-01 | 2.94E-02 | 9.98E-03 | 1.68E-03 | 2.77E-01 |
| Tier 2 95th UCL | NA | 2.15E-01 | 2.81E-02 | 9.08E-03 | 1.04E-03 | 2.53E-01 |
| *Coyote - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 1.50E+00 | NA | 8.86E-03 | 1.68E-03 | 1.51E+00 |
| Tier 1 95th UCL | NA | 9.93E-01 | NA | 5.88E-03 | 1.04E-03 | 1.00E+00 |
| Tier 2 95th UTL | NA | 9.44E-01 | NA | 5.59E-03 | 1.68E-03 | 9.51E-01 |
| Tier 2 95th UCL | NA | 8.58E-01 | NA | 5.08E-03 | 1.04E-03 | 8.65E-01 |

NA = Not applicable.

**Table A4.2.17**
**Non-PMJM Intake Estimates for Nickel**
**Alternate Exposure Scenario (Median BAFs)**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Bioaccumulation Factors** | | | | | | |
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| lnCp = -2.224+0.748(lnCs) | 1.059 | lnCm = -0.2462 + 0.4658(lnCs) | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** | |
| 21.1 | Tier 1 95th UTL | 1.06 | 22.3 | 3.24 | 0.021 | |
| 14 | Tier 1 95th UCL | 0.78 | 14.8 | 2.67 | 0.013 | |
| 13.3 | Tier 2 95th UTL | 0.75 | 14.1 | 2.61 | 0.021 | |
| 12.1 | Tier 2 95th UCL | 0.70 | 12.8 | 2.50 | 0.013 | |
| **Intake Parameters** | | | | | | |
| | **$IR_{(food)}$ (kg/kg BW day)** | **$IR_{(water)}$ (kg/kg BW day)** | **$IR_{(soil)}$ (kg/kg BW day)** | **$P_{plant}$** | **$P_{invert}$** | **$P_{mammal}$** |
| Deer Mouse - Insectivore | 0.065 | 0.19 | 0.001 | 0 | 1 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Deer Mouse - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 1.45E+00 | NA | 2.74E-02 | 3.99E-03 | 1.48E+00 |
| Tier 1 95th UCL | NA | 9.64E-01 | NA | 1.82E-02 | 2.47E-03 | 9.84E-01 |
| Tier 2 95th UTL | NA | 9.16E-01 | NA | 1.73E-02 | 3.99E-03 | 9.37E-01 |
| Tier 2 95th UCL | NA | 8.33E-01 | NA | 1.57E-02 | 2.47E-03 | 8.51E-01 |

NA = Not applicable.

**Table A4.2.18**
**PMJM Intake Estimates for Nickel**
**Default Exposure Scenario**

| | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| $lnCp = -2.224+0.748(lnCs)$ | 4.73 | $lnCm = -0.2462 + 0.4658(lnCs)$ | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Patch** | **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** |
| 19 | 19.3 | MDC | 0.99 | 91.3 | 3.10 | 0.272 |
| 19 | 19.3 | 95th UTL | 0.99 | 91.3 | 3.10 | 0.021 |
| 19 | 16.02 | 95th UCL | 0.86 | 75.8 | 2.85 | 0.013 |
| 19 | 12.88 | Mean | 0.73 | 60.9 | 2.57 | 0.01 |
| 20 | 26.3 | MDC | 1.25 | 124.4 | 3.59 | 0.272 |
| 20 | 23.37 | 95th UTL | 1.14 | 110.5 | 3.39 | 0.021 |
| 20 | 16.59 | 95th UCL | 0.88 | 78.5 | 2.89 | 0.013 |
| 20 | 14.74 | Mean | 0.81 | 69.7 | 2.74 | 0.01 |
| 21 | 21.1 | MDC | 1.06 | 99.8 | 3.24 | 0.272 |
| 21 | 21.1 | 95th UTL | 1.06 | 99.8 | 3.24 | 0.021 |
| 21 | 16.45 | 95th UCL | 0.88 | 77.8 | 2.88 | 0.013 |
| 21 | 12.05 | Mean | 0.70 | 57.0 | 2.49 | 0.01 |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| PMJM | 0.17 | 0.15 | 0.004 | 0.7 | 0.3 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Patch 19* | | | | | | |
| MDC | 1.18E-01 | 4.66E+00 | N/A | 7.87E-02 | 4.08E-02 | 4.89E+00 |
| 95th UTL | 1.18E-01 | 4.66E+00 | N/A | 7.87E-02 | 3.15E-03 | 4.86E+00 |
| 95th UCL | 1.03E-01 | 3.86E+00 | N/A | 6.54E-02 | 1.95E-03 | 4.03E+00 |
| Mean | 8.71E-02 | 3.11E+00 | N/A | 5.26E-02 | 1.50E-03 | 3.25E+00 |
| *Patch 20* | | | | | | |
| MDC | 1.49E-01 | 6.34E+00 | N/A | 1.07E-01 | 4.08E-02 | 6.64E+00 |
| 95th UTL | 1.36E-01 | 5.64E+00 | N/A | 9.53E-02 | 3.15E-03 | 5.87E+00 |
| 95th UCL | 1.05E-01 | 4.00E+00 | N/A | 6.77E-02 | 1.95E-03 | 4.18E+00 |
| Mean | 9.63E-02 | 3.56E+00 | N/A | 6.01E-02 | 1.50E-03 | 3.71E+00 |
| *Patch 21* | | | | | | |
| MDC | 1.26E-01 | 5.09E+00 | N/A | 8.61E-02 | 4.08E-02 | 5.34E+00 |
| 95th UTL | 1.26E-01 | 5.09E+00 | N/A | 8.61E-02 | 3.15E-03 | 5.31E+00 |
| 95th UCL | 1.05E-01 | 3.97E+00 | N/A | 6.71E-02 | 1.95E-03 | 4.14E+00 |
| Mean | 8.28E-02 | 2.91E+00 | N/A | 4.92E-02 | 1.50E-03 | 3.04E+00 |

NA = Not applicable or not available.

## Table A4.2.19
## PMJM Intake Estimates for Nickel
## Alternate Exposure Scenario (Median BAFs)

| Bioaccumulation Factors | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| lnCp = -2.224+0.748(lnCs) | 1.059 | lnCm = -0.2462 + 0.4658(lnCs) | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Patch** | **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** |
| 19 | 19.3 | MDC | 0.99 | 20.4 | 3.10 | 0.272 |
| 19 | 19.3 | 95th UTL | 0.99 | 20.4 | 3.10 | 0.021 |
| 19 | 16.02 | 95th UCL | 0.86 | 17.0 | 2.85 | 0.013 |
| 19 | 12.88 | Mean | 0.73 | 13.6 | 2.57 | 0.01 |
| 20 | 26.3 | MDC | 1.25 | 27.9 | 3.59 | 0.272 |
| 20 | 23.37 | 95th UTL | 1.14 | 24.7 | 3.39 | 0.021 |
| 20 | 16.59 | 95th UCL | 0.88 | 17.6 | 2.89 | 0.013 |
| 20 | 14.74 | Mean | 0.81 | 15.6 | 2.74 | 0.01 |
| 21 | 21.1 | MDC | 1.06 | 22.3 | 3.24 | 0.272 |
| 21 | 21.1 | 95th UTL | 1.06 | 22.3 | 3.24 | 0.021 |
| 21 | 16.45 | 95th UCL | 0.88 | 17.4 | 2.88 | 0.013 |
| 21 | 12.05 | Mean | 0.70 | 12.8 | 2.49 | 0.01 |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| PMJM | 0.17 | 0.15 | 0.004 | 0.7 | 0.3 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Patch 19* | | | | | | |
| MDC | 1.18E-01 | 1.04E+00 | N/A | 7.87E-02 | 4.08E-02 | 1.28E+00 |
| 95th UTL | 1.18E-01 | 1.04E+00 | N/A | 7.87E-02 | 3.15E-03 | 1.24E+00 |
| 95th UCL | 1.03E-01 | 8.65E-01 | N/A | 6.54E-02 | 1.95E-03 | 1.04E+00 |
| Mean | 8.71E-02 | 6.96E-01 | N/A | 5.26E-02 | 1.50E-03 | 8.37E-01 |
| *Patch 20* | | | | | | |
| MDC | 1.49E-01 | 1.42E+00 | N/A | 1.07E-01 | 4.08E-02 | 1.72E+00 |
| 95th UTL | 1.36E-01 | 1.26E+00 | N/A | 9.53E-02 | 3.15E-03 | 1.50E+00 |
| 95th UCL | 1.05E-01 | 8.96E-01 | N/A | 6.77E-02 | 1.95E-03 | 1.07E+00 |
| Mean | 9.63E-02 | 7.96E-01 | N/A | 6.01E-02 | 1.50E-03 | 9.54E-01 |
| *Patch 21* | | | | | | |
| MDC | 1.26E-01 | 1.14E+00 | N/A | 8.61E-02 | 4.08E-02 | 1.39E+00 |
| 95th UTL | 1.26E-01 | 1.14E+00 | N/A | 8.61E-02 | 3.15E-03 | 1.35E+00 |
| 95th UCL | 1.05E-01 | 8.88E-01 | N/A | 6.71E-02 | 1.95E-03 | 1.06E+00 |
| Mean | 8.28E-02 | 6.51E-01 | N/A | 4.92E-02 | 1.50E-03 | 7.84E-01 |

NA = Not applicable or not available.

**Table A4.2.20**
**Non-PMJM Hazard Quotients for Nickel**

| | Total Intake (mg/kg BW day) | TRV (mg/kg BW day) | | | | Hazard Quotients | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | NOAEL | LOAEL | Sample et al. (1996) NOAEL | Sample et al. (1996) LOAEL | NOAEL | LOAEL | Sample et al. (1996) NOAEL | Sample et al. (1996) LOAEL |
| **Nickel (Default Exposure)** | | | | | | | | | |
| *Mourning Dove - Insectivore* | | | | | | | | | |
| Tier 1 95th UTL | 2.34E+01 | 1.38E+00 | 5.53E+01 | 7.74E+01 | 1.07E+02 | **17** | 0.4 | 0.3 | 0.2 |
| Tier 1 95th UCL | 1.55E+01 | 1.38E+00 | 5.53E+01 | 7.74E+01 | 1.07E+02 | **11** | 0.3 | 0.2 | 0.1 |
| Tier 2 95th UTL | 1.48E+01 | 1.38E+00 | 5.53E+01 | 7.74E+01 | 1.07E+02 | **11** | 0.3 | 0.2 | 0.1 |
| Tier 2 95th UCL | 1.34E+01 | 1.38E+00 | 5.53E+01 | 7.74E+01 | 1.07E+02 | **10** | 0.2 | 0.2 | 0.1 |
| *Deer Mouse - Herbivore* | | | | | | | | | |
| Tier 1 95th UTL | 1.68E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | 1 | 0.1 | 0.004 | 0.002 |
| Tier 1 95th UCL | 1.20E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | 0.9 | 0.1 | 0.003 | 0.001 |
| Tier 2 95th UTL | 1.17E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | 0.9 | 0.1 | 0.003 | 0.001 |
| Tier 2 95th UCL | 1.07E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | 0.8 | 0.1 | 0.003 | 0.001 |
| *Deer Mouse - Insectivore* | | | | | | | | | |
| Tier 1 95th UTL | 6.52E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **49** | **5** | 0.2 | 0.1 |
| Tier 1 95th UCL | 4.32E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **33** | **3** | 0.1 | 0.1 |
| Tier 2 95th UTL | 4.11E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **31** | **3** | 0.1 | 0.1 |
| Tier 2 95th UCL | 3.74E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **28** | **3** | 0.1 | 0.0 |
| *Coyote - Generalist* | | | | | | | | | |
| Tier 1 95th UTL | 4.28E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **3** | 0.3 | 0.01 | 0.01 |
| Tier 1 95th UCL | 2.90E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **2** | 0.2 | 0.007 | 0.004 |
| Tier 2 95th UTL | 2.77E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **2** | 0.2 | 0.007 | 0.003 |
| Tier 2 95th UCL | 2.53E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **2** | 0.2 | 0.006 | 0.003 |
| *Coyote - Insectivore* | | | | | | | | | |
| Tier 1 95th UTL | 1.51E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **11** | 1 | 0.04 | 0.02 |
| Tier 1 95th UCL | 1.00E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **8** | 0.8 | 0.03 | 0.01 |
| Tier 2 95th UTL | 9.51E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **7** | 0.7 | 0.02 | 0.01 |
| Tier 2 95th UCL | 8.65E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **7** | 0.7 | 0.02 | 0.01 |
| **Nickel (Alternative Exposure Scenario; Median BAFs)** | | | | | | | | | |
| *Deer Mouse - Insectivore* | | | | | | | | | |
| Tier 1 95th UTL | 1.48E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **11** | 1 | 0.04 | 0.02 |
| Tier 1 95th UCL | 9.84E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **7** | 0.7 | 0.02 | 0.01 |
| Tier 2 95th UTL | 9.37E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **7** | 0.7 | 0.02 | 0.01 |
| Tier 2 95th UCL | 8.51E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **6** | 0.6 | 0.02 | 0.01 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

## Table A4.2.21
## PMJM Hazard Quotients for Nickel

| Patch/ EPC Statistic | Total Intake (mg/kg BW/day) | TRV (mg/kg BW/day) NOAEL | LOAEL | Sample et al. (1996) NOAEL | Sample et al. (1996) LOAEL | Hazard Quotients NOAEL | LOAEL | Sample et al. (1996) NOAEL | Sample et al. (1996) LOAEL |
|---|---|---|---|---|---|---|---|---|---|
| **Nickel (Default Exposure)** | | | | | | | | | |
| *Patch 19* | | | | | | | | | |
| MDC | 4.89E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **37** | **4** | 0.1 | 0.1 |
| 95th UTL | 4.86E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **37** | **4** | 0.1 | 0.1 |
| 95th UCL | 4.03E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **30** | **3** | 0.1 | 0.1 |
| Mean | 3.25E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **24** | **2** | 0.1 | 0.04 |
| *Patch 20* | | | | | | | | | |
| MDC | 6.64E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **50** | **5** | 0.2 | 0.1 |
| 95th UTL | 5.87E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **44** | **4** | 0.1 | 0.1 |
| 95th UCL | 4.18E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **31** | **3** | 0.1 | 0.1 |
| Mean | 3.71E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **28** | **3** | 0.1 | 0.05 |
| *Patch 21* | | | | | | | | | |
| MDC | 5.34E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **40** | **4** | 0.1 | 0.1 |
| 95th UTL | 5.31E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **40** | **4** | 0.1 | 0.1 |
| 95th UCL | 4.14E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **31** | **3** | 0.1 | 0.1 |
| Mean | 3.04E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **23** | **2** | 0.1 | 0.04 |
| **Nickel (Alternative Exposure Scenario; Median BAFs)** | | | | | | | | | |
| *Patch 19* | | | | | | | | | |
| MDC | 1.28E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **10** | 1 | 0.03 | 0.02 |
| 95th UTL | 1.24E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **9** | 0.9 | 0.03 | 0.02 |
| 95th UCL | 1.04E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **8** | 0.8 | 0.03 | 0.01 |
| Mean | 8.37E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **6** | 0.6 | 0.02 | 0.01 |
| *Patch 20* | | | | | | | | | |
| MDC | 1.72E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **13** | 1 | 0.04 | 0.02 |
| 95th UTL | 1.50E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **11** | 1 | 0.04 | 0.02 |
| 95th UCL | 1.07E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **8** | 0.8 | 0.03 | 0.01 |
| Mean | 9.54E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **7** | 0.7 | 0.02 | 0.01 |
| *Patch 21* | | | | | | | | | |
| MDC | 1.39E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **10** | 1 | 0.03 | 0.02 |
| 95th UTL | 1.35E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **10** | 1 | 0.03 | 0.02 |
| 95th UCL | 1.06E+00 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **8** | 0.8 | 0.03 | 0.01 |
| Mean | 7.84E-01 | 1.33E-01 | 1.33E+00 | 4.00E+01 | 8.00E+01 | **6** | 0.6 | 0.02 | 0.01 |

NA = Not applicable.

**Bold = Hazard quotients>1.**

**Table A4.2.22**
**Terrestrial Plant Hazard Quotients for Silver**

| EPC Statistic | Concentration (mg/kg) | TRV (mg/kg) Screening ESL | Hazard Quotients Screening ESL[a] |
|---|---|---|---|
| *Terrestrial Plant* | | | |
| Tier 1 95th UTL | 3.3 | 2.00E+00 | **2** |
| Tier 1 95th UCL | 9.69 | 2.00E+00 | **5** |
| Tier 2 95th UTL | 0.966 | 2.00E+00 | 0.5 |
| Tier 2 95th UCL | 0.633 | 2.00E+00 | 0.3 |

[a] EPA Region 5 ESL Soil Screening Benchmark
**Bold = Hazard quotients>1.**

## Table A4.2.23
## Non-PMJM Intake Estimates for Tin
## Default Exposure Scenario

| Bioaccumulation Factors | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.03 | 1 | 0.21 | | | | |
| Media Concentrations (mg/kg) | | | | | | |
| **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** | |
| 21.1 | Tier 1 95th UTL | 0.63 | 21.10 | 4.43 | 0.023 | |
| 12.7 | Tier 1 95th UCL | 0.38 | 12.70 | 2.67 | 0.010 | |
| 7.22 | Tier 2 95th UTL | 0.22 | 7.22 | 1.52 | 0.023 | |
| 5.07 | Tier 2 95th UCL | 0.15 | 5.07 | 1.06 | 0.010 | |
| Intake Parameters | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| Mourning Dove - Herbivore | 0.23 | 0.12 | 0.021 | 1 | 0 | 0 |
| Mourning Dove - Insectivore | 0.23 | 0.12 | 0.021 | 0 | 1 | 0 |
| American Kestrel | 0.092 | 0.12 | 0.005 | 0 | 0.2 | 0.8 |
| Deer Mouse - Insectivore | 0.065 | 0.19 | 0.001 | 0 | 1 | 0 |
| Intake Estimates (mg/kg BW day) | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Mourning Dove - Herbivore* | | | | | | |
| Tier 1 95th UTL | 1.46E-01 | N/A | N/A | 4.51E-01 | 2.76E-03 | 6.00E-01 |
| Tier 1 95th UCL | 8.76E-02 | N/A | N/A | 2.72E-01 | 1.20E-03 | 3.60E-01 |
| Tier 2 95th UTL | 4.98E-02 | N/A | N/A | 1.54E-01 | 2.76E-03 | 2.07E-01 |
| Tier 2 95th UCL | 3.50E-02 | N/A | N/A | 1.08E-01 | 1.20E-03 | 1.45E-01 |
| *Mourning Dove - Insectivore* | | | | | | |
| Tier 1 95th UTL | N/A | 4.85E+00 | N/A | 4.51E-01 | 2.76E-03 | 5.31E+00 |
| Tier 1 95th UCL | N/A | 2.92E+00 | N/A | 2.72E-01 | 1.20E-03 | 3.19E+00 |
| Tier 2 95th UTL | N/A | 1.66E+00 | N/A | 1.54E-01 | 2.76E-03 | 1.82E+00 |
| Tier 2 95th UCL | N/A | 1.17E+00 | N/A | 1.08E-01 | 1.20E-03 | 1.28E+00 |
| *American Kestrel* | | | | | | |
| Tier 1 95th UTL | N/A | 3.88E-01 | 3.26E-01 | 9.71E-02 | 2.76E-03 | 8.14E-01 |
| Tier 1 95th UCL | N/A | 2.34E-01 | 1.96E-01 | 5.84E-02 | 1.20E-03 | 4.90E-01 |
| Tier 2 95th UTL | N/A | 1.33E-01 | 1.12E-01 | 3.32E-02 | 2.76E-03 | 2.80E-01 |
| Tier 2 95th UCL | N/A | 9.33E-02 | 7.84E-02 | 2.33E-02 | 1.20E-03 | 1.96E-01 |
| *Deer Mouse - Insectivore* | | | | | | |
| Tier 1 95th UTL | N/A | 1.37E+00 | N/A | 2.74E-02 | 4.37E-03 | 1.40E+00 |
| Tier 1 95th UCL | N/A | 8.26E-01 | N/A | 1.65E-02 | 1.90E-03 | 8.44E-01 |
| Tier 2 95th UTL | N/A | 4.69E-01 | N/A | 9.39E-03 | 4.37E-03 | 4.83E-01 |
| Tier 2 95th UCL | N/A | 3.30E-01 | N/A | 6.59E-03 | 1.90E-03 | 3.38E-01 |

NA = Not applicable.

## Table A4.2.24
## PMJM Intake Estimates for Tin
## Default Exposure Scenario

| Bioaccumulation Factors | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.03 | 1 | 0.21 | | | | |
| Media Concentrations (mg/kg) | | | | | | |
| Patch | Soil Concentration | Statistic | Plant | Earthworm | Small Mammal | Surface Water (mg/L) |
| 19 | 66.9 | MDC | 2.0 | 66.9 | 14.0 | 0.07 |
| 19 | 66.9 | 95th UTL | 2.0 | 66.9 | 14.0 | 0.023 |
| 19 | 26.67 | 95th UCL | 0.8 | 26.7 | 5.6 | 0.01 |
| 19 | 13.426 | Mean | 0.4 | 13.4 | 2.8 | 0.007 |
| 21 | 47.6 | MDC | 1.4 | 47.6 | 10.0 | 0.07 |
| 21 | 47.6 | 95th UTL | 1.4 | 47.6 | 10.0 | 0.023 |
| 21 | 34.42 | 95th UCL | 1.0 | 34.4 | 7.2 | 0.01 |
| 21 | 21.84 | Mean | 0.7 | 21.8 | 4.6 | 0.007 |
| Intake Parameters | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| PMJM | 0.17 | 0.15 | 0.004 | 0.7 | 0.3 | 0 |
| Intake Estimates (mg/kg BW day) | | | | | | |
| | Plant Tissue | Invertebrate Tissue | Mammal Tissue | Soil | Surface Water | Total |
| *Patch 19* | | | | | | |
| MDC | 2.39E-01 | 3.41E+00 | N/A | 2.73E-01 | 1.05E-02 | 3.93E+00 |
| 95th UTL | 2.39E-01 | 3.41E+00 | N/A | 2.73E-01 | 3.45E-03 | 3.93E+00 |
| 95th UCL | 9.52E-02 | 1.36E+00 | N/A | 1.09E-01 | 1.50E-03 | 1.57E+00 |
| Mean | 4.79E-02 | 6.85E-01 | N/A | 5.48E-02 | 1.05E-03 | 7.88E-01 |
| *Patch 21* | | | | | | |
| MDC | 1.70E-01 | 2.43E+00 | N/A | 1.94E-01 | 1.05E-02 | 2.80E+00 |
| 95th UTL | 1.70E-01 | 2.43E+00 | N/A | 1.94E-01 | 3.45E-03 | 2.80E+00 |
| 95th UCL | 1.23E-01 | 1.76E+00 | N/A | 1.40E-01 | 1.50E-03 | 2.02E+00 |
| Mean | 7.80E-02 | 1.11E+00 | N/A | 8.91E-02 | 1.05E-03 | 1.28E+00 |

N/A = Not applicable or not available.

## Table A4.2.25

## Non-PMJM Hazard Quotients for Tin

| Receptor/ EPC Statistic | Total Intake (mg/kg BW day) | TRV (mg/kg BW day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | | NOAEL | LOAEL | NOAEL | LOAEL |
| **Tin (Default Exposure)** | | | | | |
| *Mourning Dove - Herbivore* | | | | | |
| Tier 1 95th UTL | 6.00E-01 | 7.30E-01 | 1.83E+01 | 1 | 0.03 |
| Tier 1 95th UCL | 3.60E-01 | 7.30E-01 | 1.83E+01 | 0.5 | 0.02 |
| Tier 2 95th UTL | 2.07E-01 | 7.30E-01 | 1.83E+01 | 0.3 | 0.01 |
| Tier 2 95th UCL | 1.45E-01 | 7.30E-01 | 1.83E+01 | 0.2 | 0.01 |
| *Mourning Dove - Insectivore* | | | | | |
| Tier 1 95th UTL | 5.31E+00 | 7.30E-01 | 1.83E+01 | **7** | 0.3 |
| Tier 1 95th UCL | 3.19E+00 | 7.30E-01 | 1.83E+01 | **4** | 0.2 |
| Tier 2 95th UTL | 1.82E+00 | 7.30E-01 | 1.83E+01 | **2** | 0.1 |
| Tier 2 95th UCL | 1.28E+00 | 7.30E-01 | 1.83E+01 | **2** | 0.1 |
| *American Kestrel* | | | | | |
| Tier 1 95th UTL | 8.14E-01 | 7.30E-01 | 1.83E+01 | 1 | 0.04 |
| Tier 1 95th UCL | 4.90E-01 | 7.30E-01 | 1.83E+01 | 0.7 | 0.03 |
| Tier 2 95th UTL | 2.80E-01 | 7.30E-01 | 1.83E+01 | 0.4 | 0.02 |
| Tier 2 95th UCL | 1.96E-01 | 7.30E-01 | 1.83E+01 | 0.3 | 0.01 |
| *Deer Mouse - Insectivore* | | | | | |
| Tier 1 95th UTL | 1.40E+00 | 2.50E-01 | 1.50E+01 | **6** | 0.1 |
| Tier 1 95th UCL | 8.44E-01 | 2.50E-01 | 1.50E+01 | **3** | 0.1 |
| Tier 2 95th UTL | 4.83E-01 | 2.50E-01 | 1.50E+01 | **2** | 0.03 |
| Tier 2 95th UCL | 3.38E-01 | 2.50E-01 | 1.50E+01 | 1 | 0.02 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

## Table A4.2.26
## PMJM Hazard Quotients for Tin

| Patch/ EPC Statistic | Total Intake (mg/kg BW day) | TRV (mg/kg BW day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | | NOAEL | LOAEL | NOAEL | LOAEL |
| **Tin (Default Exposure)** | | | | | |
| *Patch 19* | | | | | |
| MDC | 3.93E+00 | 2.50E-01 | 1.50E+01 | **16** | 0.3 |
| 95th UTL | 3.93E+00 | 2.50E-01 | 1.50E+01 | **16** | 0.3 |
| 95th UCL | 1.57E+00 | 2.50E-01 | 1.50E+01 | **6** | 0.1 |
| Mean | 7.88E-01 | 2.50E-01 | 1.50E+01 | **3** | 0.1 |
| *Patch 21* | | | | | |
| MDC | 2.80E+00 | 2.50E-01 | 1.50E+01 | **11** | 0.2 |
| 95th UTL | 2.80E+00 | 2.50E-01 | 1.50E+01 | **11** | 0.2 |
| 95th UCL | 2.02E+00 | 2.50E-01 | 1.50E+01 | **8** | 0.1 |
| Mean | 1.28E+00 | 2.50E-01 | 1.50E+01 | **5** | 0.1 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

## Table A4.2.27
## Terrestrial Plant Hazard Quotients for Uranium

| EPC Statistic | Concentration (mg/kg) | TRV (mg/kg) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | | Screening ESL | Alternate LOEC | Screening ESL | Alternate LOEC |
| *Terrestrial Plant* | | | | | |
| Tier 1 95th UTL | 85 | 5.00E+00 | 1.00E+01 | **17** | **9** |
| Tier 1 95th UCL | 55.8 | 5.00E+00 | 1.00E+01 | **11** | **6** |
| Tier 2 95th UTL | 5.66 | 5.00E+00 | 1.00E+01 | 1 | 0.6 |
| Tier 2 95th UCL | 3.64 | 5.00E+00 | 1.00E+01 | 0.7 | 0.4 |

**Bold = Hazard quotients>1.**

**Table A4.2.28**
**Non-PMJM Intake Estimates for Vanadium**
**Default Exposure Scenario**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Bioaccumulation Factors** | | | | | | |
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.0097 | 0.088 | 0.0131 | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** | |
| 47 | Tier 1 95th UTL | 0.46 | 4.1 | 0.62 | 0.04 | |
| 32.1 | Tier 1 95th UCL | 0.31 | 2.8 | 0.42 | 0.017 | |
| 36.1 | Tier 2 95th UTL | 0.35 | 3.2 | 0.47 | 0.04 | |
| 33.8 | Tier 2 95th UCL | 0.33 | 3.0 | 0.44 | 0.017 | |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammals}$ |
| Deer Mouse - Insectivore | 0.065 | 0.19 | 0.001 | 0 | 1 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Deer Mouse - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 2.69E-01 | NA | 6.11E-02 | 7.60E-03 | 3.38E-01 |
| Tier 1 95th UCL | NA | 1.84E-01 | NA | 4.17E-02 | 3.23E-03 | 2.29E-01 |
| Tier 2 95th UTL | NA | 2.06E-01 | NA | 4.69E-02 | 7.60E-03 | 2.61E-01 |
| Tier 2 95th UCL | NA | 1.93E-01 | NA | 4.39E-02 | 3.23E-03 | 2.41E-01 |

NA = Not applicable.

**Table A4.2.29**
**PMJM Intake Estimates for Vanadium**
**Default Exposure Scenario**

| | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.0097 | 0.088 | 0.0131 | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Patch** | **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** |
| 19 | 53 | MDC | 0.5 | 4.7 | 0.7 | 0.747 |
| 19 | 53 | 95th UTL | 0.5 | 4.7 | 0.7 | 0.04 |
| 19 | 44.88 | 95th UCL | 0.4 | 3.9 | 0.6 | 0.017 |
| 19 | 39.03 | Mean | 0.4 | 3.4 | 0.5 | 0.02 |
| 20 | 43.6 | MDC | 0.4 | 3.8 | 0.6 | 0.747 |
| 20 | 43.6 | 95th UTL | 0.4 | 3.8 | 0.6 | 0.04 |
| 20 | 32.59 | 95th UCL | 0.3 | 2.9 | 0.4 | 0.017 |
| 20 | 29.44 | Mean | 0.3 | 2.6 | 0.4 | 0.02 |
| 21 | 47 | MDC | 0.5 | 4.1 | 0.6 | 0.747 |
| 21 | 47 | 95th UTL | 0.5 | 4.1 | 0.6 | 0.04 |
| 21 | 46.12 | 95th UCL | 0.4 | 4.1 | 0.6 | 0.017 |
| 21 | 36.03 | Mean | 0.3 | 3.2 | 0.5 | 0.02 |
| **Intake Parameters** | | | | | | |
| | **$IR_{(food)}$ (kg/kg BW day)** | **$IR_{(water)}$ (kg/kg BW day)** | **$IR_{(soil)}$ (kg/kg BW day)** | **$P_{plant}$** | **$P_{invert}$** | **$P_{mammal}$** |
| PMJM | 0.17 | 0.15 | 0.004 | 0.7 | 0.3 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Patch 19* | | | | | | |
| MDC | 6.12E-02 | 2.38E-01 | N/A | 2.16E-01 | 1.12E-01 | 6.27E-01 |
| 95th UTL | 6.12E-02 | 2.38E-01 | N/A | 2.16E-01 | 6.00E-03 | 5.21E-01 |
| 95th UCL | 5.18E-02 | 2.01E-01 | N/A | 1.83E-01 | 2.55E-03 | 4.39E-01 |
| Mean | 4.51E-02 | 1.75E-01 | N/A | 1.59E-01 | 3.00E-03 | 3.82E-01 |
| *Patch 20* | | | | | | |
| MDC | 5.03E-02 | 1.96E-01 | N/A | 1.78E-01 | 1.12E-01 | 5.36E-01 |
| 95th UTL | 5.03E-02 | 1.96E-01 | N/A | 1.78E-01 | 6.00E-03 | 4.30E-01 |
| 95th UCL | 3.76E-02 | 1.46E-01 | N/A | 1.33E-01 | 2.55E-03 | 3.19E-01 |
| Mean | 3.40E-02 | 1.32E-01 | N/A | 1.20E-01 | 3.00E-03 | 2.89E-01 |
| *Patch 21* | | | | | | |
| MDC | 5.43E-02 | 2.11E-01 | N/A | 1.92E-01 | 1.12E-01 | 5.69E-01 |
| 95th UTL | 5.43E-02 | 2.11E-01 | N/A | 1.92E-01 | 6.00E-03 | 4.63E-01 |
| 95th UCL | 5.32E-02 | 2.07E-01 | N/A | 1.88E-01 | 2.55E-03 | 4.51E-01 |
| Mean | 4.16E-02 | 1.62E-01 | N/A | 1.47E-01 | 3.00E-03 | 3.53E-01 |

NA = Not applicable or not available.

**Table A4.2.30**

**Terrestrial Plant Hazard Quotients for Vanadium**

| EPC Statistic | Concentration (mg/kg) | TRV (mg/kg) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | | Screening ESL | Alternate LOEC | Screening ESL | Alternate LOEC |
| *Terrestrial Plant* | | | | | |
| Tier 1 UTL | 47 | 2.00 | 50.0 | **24** | 1 |
| Tier 1 UCL | 32.1 | 2.00 | 50.0 | **16** | 1 |
| Tier 2 UTL | 36.1 | 2.00 | 50.0 | **18** | 0.7 |
| Tier 2 UCL | 33.8 | 2.00 | 50.0 | **17** | 0.7 |

NA = Not applicable.

**Bold = Hazard quotients>1.**

## Table A4.2.31
## Non-PMJM Hazard Quotients for Vanadium

| | | TRV (mg/kg BW day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | Total Intake (mg/kg BW day) | NOAEL | LOAEL | NOAEL | LOAEL |
| **Vanadium (Default Exposure)** | | | | | |
| *Deer Mouse - Insectivore* | | | | | |
| Tier 1 95th UTL | 3.38E-01 | 2.10E-01 | 2.10E+00 | **2** | 0.2 |
| Tier 1 95th UCL | 2.29E-01 | 2.10E-01 | 2.10E+00 | 1 | 0.1 |
| Tier 2 95th UTL | 2.61E-01 | 2.10E-01 | 2.10E+00 | 1 | 0.1 |
| Tier 2 95th UCL | 2.41E-01 | 2.10E-01 | 2.10E+00 | 1 | 0.1 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

**Table A4.2.32**
**PMJM Hazard Quotients for Vanadium**

| Patch/ EPC Statistic | Total Intake (mg/kg BW day) | TRV (mg/kg BW day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | | NOAEL | LOAEL | NOAEL | LOAEL |
| Vanadium (Default Exposure) | | | | | |
| *Patch 19* | | | | | |
| MDC | 6.27E-01 | 2.10E-01 | 2.10E+00 | **3** | 0.3 |
| 95th UTL | 5.21E-01 | 2.10E-01 | 2.10E+00 | **2** | 0.2 |
| 95th UCL | 4.39E-01 | 2.10E-01 | 2.10E+00 | **2** | 0.2 |
| Mean | 3.82E-01 | 2.10E-01 | 2.10E+00 | **2** | 0.2 |
| *Patch 20* | | | | | |
| MDC | 5.36E-01 | 2.10E-01 | 2.10E+00 | **3** | 0.3 |
| 95th UTL | 4.30E-01 | 2.10E-01 | 2.10E+00 | **2** | 0.2 |
| 95th UCL | 3.19E-01 | 2.10E-01 | 2.10E+00 | **2** | 0.2 |
| Mean | 2.89E-01 | 2.10E-01 | 2.10E+00 | 1 | 0.1 |
| *Patch 21* | | | | | |
| MDC | 5.69E-01 | 2.10E-01 | 2.10E+00 | **3** | 0.3 |
| 95th UTL | 4.63E-01 | 2.10E-01 | 2.10E+00 | **2** | 0.2 |
| 95th UCL | 4.51E-01 | 2.10E-01 | 2.10E+00 | **2** | 0.2 |
| Mean | 3.53E-01 | 2.10E-01 | 2.10E+00 | **2** | 0.2 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

**Table A4.2.33**
**PMJM Intake Estimates for Zinc**
**Default Exposure Scenario**

| | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| lnCp = 1.575 + 0.554 (ln Cs) | lnCi = 4.449 + 0.328 (ln Cs) | lnCsm = 4.4987 + 0.0745 (ln Cs) | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Patch** | **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** |
| 19 | 160 | MDC | 80.37 | 451.99 | 131.21 | 2.19 |
| 19 | 160 | 95th UTL | 80.37 | 451.99 | 131.21 | 0.395 |
| 19 | 102.24 | 95th UCL | 62.71 | 390.24 | 126.90 | 0.131 |
| 19 | 75.62 | Mean | 53.06 | 353.48 | 124.08 | 0.113 |
| 20 | 199 | MDC | 90.69 | 485.51 | 133.36 | 2.19 |
| 20 | 167.83 | 95th UTL | 82.53 | 459.13 | 131.68 | 0.395 |
| 20 | 99.54 | 95th UCL | 61.79 | 386.83 | 126.65 | 0.131 |
| 20 | 81.3 | Mean | 55.23 | 361.98 | 124.76 | 0.113 |
| 21 | 72 | MDC | 51.64 | 347.84 | 123.63 | 2.19 |
| 21 | 72 | 95th UTL | 51.64 | 347.84 | 123.63 | 0.395 |
| 21 | 63.66 | 95th UCL | 48.23 | 334.08 | 122.50 | 0.131 |
| 21 | 51 | Mean | 42.66 | 310.64 | 120.50 | 0.113 |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| PMJM | 0.17 | 0.15 | 0.004 | 0.7 | 0.3 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Patch 19* | | | | | | |
| MDC | 9.56E+00 | 2.31E+01 | N/A | 6.53E-01 | 3.29E-01 | 3.36E+01 |
| 95th UTL | 9.56E+00 | 2.31E+01 | N/A | 6.53E-01 | 5.93E-02 | 3.33E+01 |
| 95th UCL | 7.46E+00 | 1.99E+01 | N/A | 4.17E-01 | 1.97E-02 | 2.78E+01 |
| Mean | 6.31E+00 | 1.80E+01 | N/A | 3.09E-01 | 1.70E-02 | 2.47E+01 |
| *Patch 20* | | | | | | |
| MDC | 1.08E+01 | 2.48E+01 | N/A | 8.12E-01 | 3.29E-01 | 3.67E+01 |
| 95th UTL | 9.82E+00 | 2.34E+01 | N/A | 6.85E-01 | 5.93E-02 | 3.40E+01 |
| 95th UCL | 7.35E+00 | 1.97E+01 | N/A | 4.06E-01 | 1.97E-02 | 2.75E+01 |
| Mean | 6.57E+00 | 1.85E+01 | N/A | 3.32E-01 | 1.70E-02 | 2.54E+01 |
| *Patch 21* | | | | | | |
| MDC | 6.15E+00 | 1.77E+01 | N/A | 2.94E-01 | 3.29E-01 | 2.45E+01 |
| 95th UTL | 6.15E+00 | 1.77E+01 | N/A | 2.94E-01 | 5.93E-02 | 2.42E+01 |
| 95th UCL | 5.74E+00 | 1.70E+01 | N/A | 2.60E-01 | 1.97E-02 | 2.31E+01 |
| Mean | 5.08E+00 | 1.58E+01 | N/A | 2.08E-01 | 1.70E-02 | 2.11E+01 |

NA = Not applicable or not available.

## Table A4.2.34

## PMJM Hazard Quotients for Zinc

| Patch/ EPC Statistic | Total Intake (mg/kg BW day) | TRV (mg/kg BW day) NOAEL | TRV (mg/kg BW day) LOAEL | Hazard Quotients NOAEL | Hazard Quotients LOAEL |
|---|---|---|---|---|---|
| Zinc (Default Exposure) | | | | | |
| *Patch 19* | | | | | |
| MDC | 3.36E+01 | 9.61E+00 | 4.11E+02 | **3** | 0.1 |
| 95th UTL | 3.33E+01 | 9.61E+00 | 4.11E+02 | **3** | 0.1 |
| 95th UCL | 2.78E+01 | 9.61E+00 | 4.11E+02 | **3** | 0.1 |
| Mean | 2.47E+01 | 9.61E+00 | 4.11E+02 | **3** | 0.1 |
| *Patch 20* | | | | | |
| MDC | 3.67E+01 | 9.61E+00 | 4.11E+02 | **4** | 0.1 |
| 95th UTL | 3.40E+01 | 9.61E+00 | 4.11E+02 | **4** | 0.1 |
| 95th UCL | 2.75E+01 | 9.61E+00 | 4.11E+02 | **3** | 0.1 |
| Mean | 2.54E+01 | 9.61E+00 | 4.11E+02 | **3** | 0.1 |
| *Patch 21* | | | | | |
| MDC | 2.45E+01 | 9.61E+00 | 4.11E+02 | **3** | 0.1 |
| 95th UTL | 2.42E+01 | 9.61E+00 | 4.11E+02 | **3** | 0.1 |
| 95th UCL | 2.31E+01 | 9.61E+00 | 4.11E+02 | **2** | 0.1 |
| Mean | 2.11E+01 | 9.61E+00 | 4.11E+02 | **2** | 0.1 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

**Table A4.2.35**
**Non-PMJM Intake Estimates for Bis(2-ethylhexyl)phthalate**
**Default Exposure Scenario**

| Bioaccumulation Factors | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.15 | 34.9 | 28.81 | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** | |
| 0.41 | Tier 1 95th UTL | 0.06 | 14.3 | 11.81 | 0.013 | |
| 0.443 | Tier 1 95th UCL | 0.07 | 15.5 | 12.76 | 0.014 | |
| 0.275 | Tier 2 95th UTL | 0.04 | 9.6 | 7.92 | 0.013 | |
| 0.243 | Tier 2 95th UCL | 0.04 | 8.5 | 7.00 | 0.014 | |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| Mourning Dove - Insectivore | 0.23 | 0.12 | 0.021 | 0 | 1 | 0 |
| American Kestrel | 0.092 | 0.12 | 0.005 | 0 | 0.2 | 0.8 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Mourning Dove - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 3.29E+00 | NA | 8.77E-03 | 1.56E-03 | 3.30E+00 |
| Tier 1 95th UCL | NA | 3.56E+00 | NA | 9.48E-03 | 1.68E-03 | 3.57E+00 |
| Tier 2 95th UTL | NA | 2.21E+00 | NA | 5.88E-03 | 1.56E-03 | 2.21E+00 |
| Tier 2 95th UCL | NA | 1.95E+00 | NA | 5.20E-03 | 1.68E-03 | 1.96E+00 |
| *American Kestrel* | | | | | | |
| Tier 1 95th UTL | NA | 2.63E-01 | 8.69E-01 | 1.89E-03 | 1.56E-03 | 1.14E+00 |
| Tier 1 95th UCL | NA | 2.84E-01 | 9.39E-01 | 2.04E-03 | 1.68E-03 | 1.23E+00 |
| Tier 2 95th UTL | NA | 1.77E-01 | 5.83E-01 | 1.27E-03 | 1.56E-03 | 7.63E-01 |
| Tier 2 95th UCL | NA | 1.56E-01 | 5.15E-01 | 1.12E-03 | 1.68E-03 | 6.74E-01 |

NA = Not applicable.

## Table A4.2.36
## Non-PMJM Hazard Quotients for Bis(2-ethylhexyl)phthalate

| | | TRV (mg/kg BW day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | Total Intake (mg/kg BW day) | NOAEL | LOAEL | NOAEL | LOAEL |
| **Bis(2-ethylhexyl)phthalate (Default Exposure)** | | | | | |
| *Mourning Dove - Insectivore* | | | | | |
| Tier 1 95th UTL | 3.30E+00 | 1.10E+00 | 2.14E+02 | **3** | 0.02 |
| Tier 1 95th UCL | 3.57E+00 | 1.10E+00 | 2.14E+02 | **3** | 0.02 |
| Tier 2 95th UTL | 2.21E+00 | 1.10E+00 | 2.14E+02 | **2** | 0.01 |
| Tier 2 95th UCL | 1.96E+00 | 1.10E+00 | 2.14E+02 | **2** | 0.01 |
| *American Kestrel* | | | | | |
| Tier 1 95th UTL | 1.14E+00 | 1.10E+00 | 2.14E+02 | 1 | 0.01 |
| Tier 1 95th UCL | 1.23E+00 | 1.10E+00 | 2.14E+02 | 1 | 0.01 |
| Tier 2 95th UTL | 7.63E-01 | 1.10E+00 | 2.14E+02 | 0.7 | 0.004 |
| Tier 2 95th UCL | 6.74E-01 | 1.10E+00 | 2.14E+02 | 0.6 | 0.003 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

**Table A4.2.37**
**Non-PMJM Intake Estimates for Di-n-butylphthalate**
**Default Exposure Scenario**

| Bioaccumulation Factors | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.39 | 30.1 | 28.43 | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** | |
| 0.41 | Tier 1 95th UTL | 0.16 | 12.3 | 11.66 | 0.0055 | |
| 0.302 | Tier 1 95th UCL | 0.12 | 9.1 | 8.59 | 0.005043 | |
| 0.2768 | Tier 2 95th UTL | 0.11 | 8.3 | 7.87 | 0.0055 | |
| 0.2458 | Tier 2 95th UCL | 0.10 | 7.4 | 6.99 | 0.005043 | |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| Mourning Dove - Insectivore | 0.23 | 0.12 | 0.021 | 0 | 1 | 0 |
| American Kestrel | 0.092 | 0.12 | 0.005 | 0 | 0.2 | 0.8 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Mourning Dove - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 2.84E+00 | NA | 8.77E-03 | 6.60E-04 | 2.85E+00 |
| Tier 1 95th UCL | NA | 2.09E+00 | NA | 6.46E-03 | 6.05E-04 | 2.10E+00 |
| Tier 2 95th UTL | NA | 1.92E+00 | NA | 5.92E-03 | 6.60E-04 | 1.92E+00 |
| Tier 2 95th UCL | NA | 1.70E+00 | NA | 5.26E-03 | 6.05E-04 | 1.71E+00 |
| *American Kestrel* | | | | | | |
| Tier 1 95th UTL | NA | 2.27E-01 | 8.58E-01 | 1.89E-03 | 6.60E-04 | 1.09E+00 |
| Tier 1 95th UCL | NA | 1.67E-01 | 6.32E-01 | 1.39E-03 | 6.05E-04 | 8.01E-01 |
| Tier 2 95th UTL | NA | 1.53E-01 | 5.79E-01 | 1.27E-03 | 6.60E-04 | 7.34E-01 |
| Tier 2 95th UCL | NA | 1.36E-01 | 5.14E-01 | 1.13E-03 | 6.05E-04 | 6.52E-01 |

NA = Not applicable.

**Table A4.2.38**

**Non-PMJM Hazard Quotients for Di-n-butylphthalate**

| | | TRV (mg/kg BW day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | Total Intake (mg/kg BW day) | NOAEL | LOAEL | NOAEL | LOAEL |
| **Di-n-butylphthalate (Default Exposure)** | | | | | |
| *Mourning Dove - Insectivore* | | | | | |
| Tier 1 95th UTL | 2.85E+00 | 1.10E-01 | 1.10E+00 | **26** | **3** |
| Tier 1 95th UCL | 2.10E+00 | 1.10E-01 | 1.10E+00 | **19** | **2** |
| Tier 2 95th UTL | 1.92E+00 | 1.10E-01 | 1.10E+00 | **17** | **2** |
| Tier 2 95th UCL | 1.71E+00 | 1.10E-01 | 1.10E+00 | **16** | **2** |
| *American Kestrel* | | | | | |
| Tier 1 95th UTL | 1.09E+00 | 1.10E-01 | 1.10E+00 | **10** | 1 |
| Tier 1 95th UCL | 8.01E-01 | 1.10E-01 | 1.10E+00 | **7** | 0.7 |
| Tier 2 95th UTL | 7.34E-01 | 1.10E-01 | 1.10E+00 | **7** | 0.7 |
| Tier 2 95th UCL | 6.52E-01 | 1.10E-01 | 1.10E+00 | **6** | 0.6 |

NA = Not applicable.

**Bold = Hazard quotients>1.**

## Table A4.2.39
## Non-PMJM Intake Estimates for Total Dioxin (Mammals)
## Default Exposure Scenario

| Bioaccumulation Factors | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.22 | lnCi = 3.533 + 1.182(lnCs) | lnCsm = 0.8113 + 1.0993(lnCs) | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** | |
| 0.000074 | Tier 1 95th UTL | 0.000016 | 0.000377 | 0.000065 | 0 | |
| 0.000055 | Tier 1 95th UCL | 0.000012 | 0.000264 | 0.000047 | 0 | |
| NA | Tier 2 95th UTL | NA | NA | NA | NA | |
| NA | Tier 2 95th UCL | NA | NA | NA | NA | |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| Deer Mouse - Herbivore | 0.111 | 0.19 | 0.002 | 1 | 0 | 0 |
| Deer Mouse - Insectivore | 0.065 | 0.19 | 0.001 | 0 | 1 | 0 |
| Coyote - Generalist | 0.015 | 0.08 | 0.001 | 0 | 0.25 | 0.75 |
| Coyote - Insectivore | 0.015 | 0.08 | 0.0004 | 0 | 1 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Deer Mouse - Herbivore* | | | | | | |
| Tier 1 95th UTL | 1.81E-06 | NA | NA | 1.64E-07 | 0.00E+00 | 1.97E-06 |
| Tier 1 95th UCL | 1.34E-06 | NA | NA | 1.22E-07 | 0.00E+00 | 1.47E-06 |
| Tier 2 95th UTL | NA | NA | NA | NA | NA | NA |
| Tier 2 95th UCL | NA | NA | NA | NA | NA | NA |
| *Deer Mouse - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 2.45E-05 | NA | 9.62E-08 | 0.00E+00 | 2.46E-05 |
| Tier 1 95th UCL | NA | 1.72E-05 | NA | 7.15E-08 | 0.00E+00 | 1.72E-05 |
| Tier 2 95th UTL | NA | NA | NA | NA | NA | NA |
| Tier 2 95th UCL | NA | NA | NA | NA | NA | NA |
| *Coyote - Generalist* | | | | | | |
| Tier 1 95th UTL | NA | 1.41E-06 | 7.29E-07 | 5.55E-08 | 0.00E+00 | 2.20E-06 |
| Tier 1 95th UCL | NA | 9.90E-07 | 5.26E-07 | 4.13E-08 | 0.00E+00 | 1.56E-06 |
| Tier 2 95th UTL | NA | NA | NA | NA | NA | NA |
| Tier 2 95th UCL | NA | NA | NA | NA | NA | NA |
| *Coyote - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 5.65E-06 | NA | 3.11E-08 | 0.00E+00 | 5.68E-06 |
| Tier 1 95th UCL | NA | 3.96E-06 | NA | 2.31E-08 | 0.00E+00 | 3.98E-06 |
| Tier 2 95th UTL | NA | NA | NA | NA | NA | NA |
| Tier 2 95th UCL | NA | NA | NA | NA | NA | NA |

NA = Not applicable or not available.

## Table A4.2.40
## Non-PMJM Intake Estimates for Total Dioxin (Birds)
## Default Exposure Scenario

| Bioaccumulation Factors | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.22 | lnCi = 3.53 + 1.2(lnCs) | lnCsm = 0.8113 + 1.0993(lnCs) | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** | |
| 0.000126 | Tier 1 95th UTL | 0.000028 | 0.000714 | 0.000116 | 0 | |
| 0.000096 | Tier 1 95th UCL | 0.000021 | 0.000515 | 0.000086 | 0 | |
| NA | Tier 2 95th UTL | NA | NA | NA | NA | |
| NA | Tier 2 95th UCL | NA | NA | NA | NA | |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| Mourning Dove - Insectivore | 0.23 | 0.12 | 0.021 | 0 | 1 | 0 |
| American Kestrel | 0.092 | 0.12 | 0.005 | 0 | 0.2 | 0.8 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Mourning Dove - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 1.64E-04 | NA | 2.70E-06 | 0.00E+00 | 1.67E-04 |
| Tier 1 95th UCL | NA | 1.18E-04 | NA | 2.05E-06 | 0.00E+00 | 1.20E-04 |
| Tier 2 95th UTL | NA | NA | NA | NA | NA | NA |
| Tier 2 95th UCL | NA | NA | NA | NA | NA | NA |
| *American Kestrel* | | | | | | |
| Tier 1 95th UTL | NA | 1.31E-05 | 8.56E-06 | 5.80E-07 | 0.00E+00 | 2.23E-05 |
| Tier 1 95th UCL | NA | 9.48E-06 | 6.35E-06 | 4.42E-07 | 0.00E+00 | 1.63E-05 |
| Tier 2 95th UTL | NA | NA | NA | NA | NA | NA |
| Tier 2 95th UCL | NA | NA | NA | NA | NA | NA |

NA = Not applicable or not available.

## Table A4.2.41
## Non-PMJM Hazard Quotients for Total Dioxin (mammals only)

| | Total Intake (mg/kg BW day) | TRV (mg/kg BW day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | | NOAEL | LOAEL | NOAEL | LOAEL |
| **Total Dioxin (Default Exposure)** | | | | | |
| *Deer Mouse - Herbivore* | | | | | |
| Tier 1 95th UTL | 1.97E-06 | 1.00E-06 | 1.00E-05 | **2** | 0.2 |
| Tier 1 95th UCL | 1.47E-06 | 1.00E-06 | 1.00E-05 | 1 | 0.1 |
| Tier 2 95th UTL | NA | 1.00E-06 | 1.00E-05 | NA | NA |
| Tier 2 95th UCL | NA | 1.00E-06 | 1.00E-05 | NA | NA |
| *Deer Mouse - Insectivore* | | | | | |
| Tier 1 95th UTL | 2.46E-05 | 1.00E-06 | 1.00E-05 | **25** | **2** |
| Tier 1 95th UCL | 1.72E-05 | 1.00E-06 | 1.00E-05 | **17** | **2** |
| Tier 2 95th UTL | NA | 1.00E-06 | 1.00E-05 | NA | NA |
| Tier 2 95th UCL | NA | 1.00E-06 | 1.00E-05 | NA | NA |
| *Coyote - Generalist* | | | | | |
| Tier 1 95th UTL | 2.20E-06 | 1.00E-06 | 1.00E-05 | **2** | 0.2 |
| Tier 1 95th UCL | 1.56E-06 | 1.00E-06 | 1.00E-05 | **2** | 0.2 |
| Tier 2 95th UTL | NA | 1.00E-06 | 1.00E-05 | NA | NA |
| Tier 2 95th UCL | NA | 1.00E-06 | 1.00E-05 | NA | NA |
| *Coyote - Insectivore* | | | | | |
| Tier 1 95th UTL | 5.68E-06 | 1.00E-06 | 1.00E-05 | **6** | 0.6 |
| Tier 1 95th UCL | 3.98E-06 | 1.00E-06 | 1.00E-05 | **4** | 0.4 |
| Tier 2 95th UTL | NA | 1.00E-06 | 1.00E-05 | NA | NA |
| Tier 2 95th UCL | NA | 1.00E-06 | 1.00E-05 | NA | NA |

NA = Not applicable or not available.
**Bold = Hazard quotients>1.**

## Table A4.2.42

### Non-PMJM Hazard Quotients for Total Dioxin (birds only)

| | Total Intake (mg/kg BW day) | TRV (mg/kg BW day) NOAEL | TRV (mg/kg BW day) LOAEL | Hazard Quotients NOAEL | Hazard Quotients LOAEL |
|---|---|---|---|---|---|
| **Total Dioxin (Default Exposure)** | | | | | |
| *Mourning Dove - Insectivore* | | | | | |
| Tier 1 95th UTL | 1.67E-04 | 1.40E-05 | 1.40E-04 | **12** | **1** |
| Tier 1 95th UCL | 1.20E-04 | 1.40E-05 | 1.40E-04 | **9** | 0.9 |
| Tier 2 95th UTL | NA | 1.40E-05 | 1.40E-04 | NA | NA |
| Tier 2 95th UCL | NA | 1.40E-05 | 1.40E-04 | NA | NA |
| *American Kestrel* | | | | | |
| Tier 1 95th UTL | 2.23E-05 | 1.40E-05 | 1.40E-04 | **2** | 0.2 |
| Tier 1 95th UCL | 1.63E-05 | 1.40E-05 | 1.40E-04 | 1 | 0.1 |
| Tier 2 95th UTL | NA | 1.40E-05 | 1.40E-04 | NA | NA |
| Tier 2 95th UCL | NA | 1.40E-05 | 1.40E-04 | NA | NA |

NA = Not applicable or not available.
**Bold = Hazard quotients>1.**

## Table A4.2.43
## Non-PMJM Intake Estimates for Total PCBs
## Default Exposure Scenario

| Bioaccumulation Factors | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.25 | lnCe = 1.41 + 1.361(lnCs) | log(Csm) = 0.246 * ((0.5*0.25)+(0.5*Cinv/Csoil)) | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** | |
| 1.3 | Tier 1 95th UTL | 0.33 | 5.9 | 1.79 | 0 | |
| 0.727 | Tier 1 95th UCL | 0.18 | 2.7 | 1.62 | 0 | |
| 0.202 | Tier 2 95th UTL | 0.05 | 0.5 | 1.37 | 0 | |
| 0.154 | Tier 2 95th UCL | 0.04 | 0.3 | 1.33 | 0 | |
| **Intake Parameters** | | | | | | |
| | $IR_{(food)}$ (kg/kg BW day) | $IR_{(water)}$ (kg/kg BW day) | $IR_{(soil)}$ (kg/kg BW day) | $P_{plant}$ | $P_{invert}$ | $P_{mammal}$ |
| Mourning Dove - Herbivore | 0.23 | 0.12 | 0.021 | 1 | 0 | 0 |
| Mourning Dove - Insectivore | 0.23 | 0.12 | 0.021 | 0 | 1 | 0 |
| American Kestrel | 0.092 | 0.12 | 0.005 | 0 | 0.2 | 0.8 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Mourning Dove - Herbivore* | | | | | | |
| Tier 1 95th UTL | 7.48E-02 | NA | NA | 2.78E-02 | 0.00E+00 | 1.03E-01 |
| Tier 1 95th UCL | 4.18E-02 | NA | NA | 1.56E-02 | 0.00E+00 | 5.74E-02 |
| Tier 2 95th UTL | 1.16E-02 | NA | NA | 4.32E-03 | 0.00E+00 | 1.59E-02 |
| Tier 2 95th UCL | 8.86E-03 | NA | NA | 3.29E-03 | 0.00E+00 | 1.21E-02 |
| *Mourning Dove - Insectivore* | | | | | | |
| Tier 1 95th UTL | NA | 1.35E+00 | NA | 2.78E-02 | 0.00E+00 | 1.37E+00 |
| Tier 1 95th UCL | NA | 6.10E-01 | NA | 1.56E-02 | 0.00E+00 | 6.26E-01 |
| Tier 2 95th UTL | NA | 1.07E-01 | NA | 4.32E-03 | 0.00E+00 | 1.11E-01 |
| Tier 2 95th UCL | NA | 7.38E-02 | NA | 3.29E-03 | 0.00E+00 | 7.71E-02 |
| *American Kestrel* | | | | | | |
| Tier 1 95th UTL | NA | 1.08E-01 | 1.32E-01 | 5.98E-03 | 0.00E+00 | 2.46E-01 |
| Tier 1 95th UCL | NA | 4.88E-02 | 1.19E-01 | 3.34E-03 | 0.00E+00 | 1.71E-01 |
| Tier 2 95th UTL | NA | 8.55E-03 | 1.01E-01 | 9.29E-04 | 0.00E+00 | 1.10E-01 |
| Tier 2 95th UCL | NA | 5.91E-03 | 9.81E-02 | 7.08E-04 | 0.00E+00 | 1.05E-01 |

NA = Not applicable.

## Table A4.2.44
## PMJM Intake Estimates for Total PCBs

| | | | | | | |
|---|---|---|---|---|---|---|
| Soil to Plant | Soil to Invertebrate | Soil to Small Mammal | | | | |
| 0.25 | lnCe = 1.41 + 1.361(lnCs) | log(Csm) = 0.246 * ((0.5*0.25)+(0.5*Cinv/Csoil)) | | | | |
| **Media Concentrations (mg/kg)** | | | | | | |
| **Patch** | **Soil Concentration** | **Statistic** | **Plant** | **Earthworm** | **Small Mammal** | **Surface Water (mg/L)** |
| 20 | 3.9 | MDC | 1.0 | 26.1 | 2.35 | 0 |
| 20 | 3.18046 | 95th UTL | 0.8 | 19.8 | 2.22 | 0 |
| 20 | 1.31424 | 95th UCL | 0.3 | 5.9 | 1.80 | 0 |
| 20 | 0.79133 | Mean | 0.2 | 3.0 | 1.64 | 0 |
| **Intake Parameters** | | | | | | |
| | **$IR_{(food)}$ (kg/kg BW day)** | **$IR_{(water)}$ (kg/kg BW day)** | **$IR_{(soil)}$ (kg/kg BW day)** | **$P_{plant}$** | **$P_{invert}$** | **$P_{mammal}$** |
| PMJM | 0.17 | 0.15 | 0.004 | 0.7 | 0.3 | 0 |
| **Intake Estimates (mg/kg BW day)** | | | | | | |
| | **Plant Tissue** | **Invertebrate Tissue** | **Mammal Tissue** | **Soil** | **Surface Water** | **Total** |
| *Patch 20* | | | | | | |
| MDC | 1.16E-01 | 1.33E+00 | N/A | 1.59E-02 | N/A | 1.46E+00 |
| 95th UTL | 9.46E-02 | 1.01E+00 | N/A | 1.30E-02 | N/A | 1.12E+00 |
| 95th UCL | 3.91E-02 | 3.03E-01 | N/A | 5.36E-03 | N/A | 3.47E-01 |
| Mean | 2.35E-02 | 1.52E-01 | N/A | 3.23E-03 | N/A | 1.79E-01 |

NA = Not applicable or not available.

## Table A4.2.45
## Non-PMJM Hazard Quotients for Total PCBs

| | | TRV (mg/kg BW day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | Total Intake (mg/kg BW day) | NOAEL | LOAEL | NOAEL | LOAEL |
| **Total PCBs (Default Exposure)** | | | | | |
| *Mourning Dove - Herbivore* | | | | | |
| Tier 1 95th UTL | 1.03E-01 | 9.00E-02 | 1.27E+00 | 1 | 0.1 |
| Tier 1 95th UCL | 5.74E-02 | 9.00E-02 | 1.27E+00 | 0.6 | 0.05 |
| Tier 2 95th UTL | 1.59E-02 | 9.00E-02 | 1.27E+00 | 0.2 | 0.01 |
| Tier 2 95th UCL | 1.21E-02 | 9.00E-02 | 1.27E+00 | 0.1 | 0.01 |
| *Mourning Dove - Insectivore* | | | | | |
| Tier 1 95th UTL | 1.37E+00 | 9.00E-02 | 1.27E+00 | **15** | 1 |
| Tier 1 95th UCL | 6.26E-01 | 9.00E-02 | 1.27E+00 | **7** | 0.5 |
| Tier 2 95th UTL | 1.11E-01 | 9.00E-02 | 1.27E+00 | 1 | 0.1 |
| Tier 2 95th UCL | 7.71E-02 | 9.00E-02 | 1.27E+00 | 1 | 0.1 |
| *American Kestrel* | | | | | |
| Tier 1 95th UTL | 2.46E-01 | 9.00E-02 | 1.27E+00 | **3** | 0.2 |
| Tier 1 95th UCL | 1.71E-01 | 9.00E-02 | 1.27E+00 | **2** | 0.1 |
| Tier 2 95th UTL | 1.10E-01 | 9.00E-02 | 1.27E+00 | 1 | 0.1 |
| Tier 2 95th UCL | 1.05E-01 | 9.00E-02 | 1.27E+00 | 1 | 0.1 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

## Table A4.2.46
## PMJM Hazard Quotients for Total PCBs

| Patch/ EPC Statistic | Total Intake (mg/kg BW day) | TRV (mg/kg BW day) | | Hazard Quotients | |
|---|---|---|---|---|---|
| | | NOAEL | LOAEL | NOAEL | LOAEL |
| Total PCBs (Default Exposure) | | | | | |
| *Patch 20* | | | | | |
| MDC | 1.46E+00 | 3.60E-01 | 7.10E-01 | **4** | **2** |
| 95th UTL | 1.12E+00 | 3.60E-01 | 7.10E-01 | **3** | **2** |
| 95th UCL | 3.47E-01 | 3.60E-01 | 7.10E-01 | 1 | 0.5 |
| Mean | 1.79E-01 | 3.60E-01 | 7.10E-01 | 0.5 | 0.3 |

NA = Not applicable.
**Bold = Hazard quotients>1.**

# COMPREHENSIVE RISK ASSESSMENT

## UPPER WOMAN DRAINAGE EXPOSURE UNIT

## VOLUME 10: ATTACHMENT 5

## Chemical-Specific Uncertainty Analysis

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| BAF | Bioaccumulation Factors |
| BW | body weight |
| CMS | Corrective Measures Study |
| CRA | Comprehensive Risk Assessment |
| ECOPC | ecological contaminant of potential concern |
| EcoSSL | Ecological Soil Screening Level |
| EPA | U.S. Environmental Protection Agency |
| EPC | exposure point concentration |
| ESL | ecological screening level |
| FS | Feasibility Study |
| HQ | hazard quotient |
| LOAEL | lowest observed adverse effect level |
| LOEC | lowest observed effect concentration |
| mg/kg | milligrams per kilogram |
| mg/kg/BW/day | milligram per kilogram per receptor body weight per day |
| NOAEL | no observed adverse effect level |
| PMJM | Preble's meadow jumping mouse |
| PRC | PRC Environmental Management, Inc. |
| RCRA | Resource Conservation and Recovery Act |
| RFETS | Rocky Flats Environmental Technology Site |
| TRV | toxicity reference value |
| UCL | upper confidence limit |

UTL upper tolerance limit

## 1.0 INTRODUCTION

One potential limitation of the hazard quotient (HQ) approach is that calculated HQ values may sometimes be uncertain due to simplifications and assumptions in the underlying exposure and toxicity data used to derive the HQs. Where possible, this risk assessment provides information on two potential sources of uncertainty, described below.

- **Bioaccumulation Factors (BAFs).** For wildlife receptors, concentrations of contaminants in dietary items were estimated from surface soil using uptake equations. When the uptake equation was based on a simple linear model (e.g., Ctissue = BAF * Csoil), the default exposure scenario used a high-end estimate of the BAF (the 90th percentile BAF). However, the use of high-end BAFs may tend to overestimate tissue concentrations in some dietary items. If necessary, in order to estimate more typical tissue concentrations, an alternate exposure scenario calculated total chemical intake using a 50th percentile (median) BAF. The use of the median BAF is consistent with the approach used in the ecological soil screening level (EcoSSL) guidance (EPA 2005).
- **Toxicity Reference Values (TRVs).** The Comprehensive Risk Assessment (CRA) Methodology utilized an established hierarchy to identify the most appropriate default TRVs for use in the ecological contaminant of potential concern (ECOPC) selection. However, in some instances, the default TRV selected may be overly conservative with regard to characterizing population-level risks. The determination of whether the default TRVs are thought to yield overly conservative estimates of risk is addressed in the uncertainty sections below on a chemical-by-chemical basis. If lowest observed adverse effect level (LOAEL) HQs greater than 1 were calculated using the default HQ calculations and an alternate TRV is identified, the chemical-specific uncertainty sections provide a discussion of why the alternate TRV is thought to be appropriate to provide an alternative estimate of toxicity (e.g., endpoint relevance, species relevance, data quality, chemical form, etc.), and HQs were calculated using both default and alternate TRVs.

The influences of each of these uncertainties on the calculated HQs are discussed for each ECOPC in the following subsections.

### 1.1 Antimony

#### *Bioaccumulation Factors*

There are several important uncertainties associated with the intake and HQ calculations for vertebrate receptors. Antimony has two types of BAFs used in the intake calculations. For the soil-to-plant BAF, a regression equation from EPA (2003) was used to estimate plant tissue concentrations. Confidence placed in this value is high; however, uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. In many cases, regression-based models are the best available predictor of tissue concentrations but may still overestimate or underestimate plant tissue concentrations of antimony to an unknown degree.

Considerable uncertainty is placed in the soil-to-invertebrate and soil-to-small mammal BAFs for antimony. No soil-to-invertebrate BAF was identified in the CRA Methodology and, therefore, a default value of 1 was used as the BAF. As a result, all intake calculations assume that antimony concentrations in terrestrial invertebrate tissues are equal to concentrations in surface soils. Because antimony is not typically a bioaccumulative compound, this assumption is likely to overestimate antimony concentrations and subsequent risk estimations to an unknown degree. The soil-to-small mammal BAF utilizes both the soil-to-plant and soil-to-invertebrate BAFs in addition to a food-to-small mammal BAF to estimate small mammal tissue concentrations. Given the uncertainties associated with the soil-to-invertebrate TRV and the added uncertainty of the food-to-small mammal BAF, the total uncertainty related to the soil-to-small mammal BAF is large. However, it is unclear as to whether the BAF overestimates or underestimates the concentration of antimony in small mammal tissues, and the degree of effects that the uncertainty has on the intake calculations is unknown.

***Plant Toxicity***

Toxicity information on the effects of antimony to plants is extremely limited. The summary of antimony toxicity in Efroymson et al. (1997a) places low confidence in the value because there are no primary reference data showing toxicity to plants and the no observed adverse effect level (NOAEL) ecological screening level (ESL) value is based on unspecified toxic effects. No additional TRVs were available in the literature. The uncertainty associated with the lack of toxicity data for terrestrial plants is high. It is unclear whether risks are overestimated or underestimated by using the default toxicity value.

***Toxicity Reference Values***

For mammalian receptors, review of the toxicity data provided in EPA (2003) indicates that only one bounded LOAEL, used in the risk estimation, is lower than the geometric mean of growth and reproduction NOAEL TRVs. All other bounded LOAEL TRVs for growth, reproduction, and mortality are more than an order of magnitude greater than the NOAEL and LOAEL used as the default TRVs. The default NOAEL and LOAEL TRVs for antimony are based on a decrease in rat progeny weight, and the effect of a predicted decrease in birth weight on the mammalian receptors in the UWOEU is unknown. Given that the geometric mean NOAEL TRV is less than the next lowest, bounded LOAEL TRV and the uncertainty regarding whether the endpoint predicted by the default LOAEL TRV is predictive of population-level effects, the geometric mean NOAEL provides a useful comparison point versus the default TRV.

***Background Risk Calculations***

Antimony was not detected in background surface soils. Therefore, background risks were not calculated for antimony in Appendix A, Volume 2, Attachment 9 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial

Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report).

## 1.2 Chromium

### *Bioaccumulation Factors*

There are several important uncertainties associated with the intake and HQ calculations for vertebrate receptors. Chromium has two types of bioaccumulation factors used in the intake calculations. For the soil-to-small mammal BAF, a regression equation was used to estimate tissue concentrations. Confidence placed in this value is high; however, uncertainty is unavoidable when using even high quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate tissue concentrations of chromium to an unknown degree.

The soil-to-invertebrate and soil-to-plant BAFs used to estimate invertebrate tissue concentrations are both based on screening-level upper-bound (90th percentile) BAFs presented in Sample et al. (1998a) and ORNL (1998). These values provide conservative estimates of uptake from soils to invertebrate and plant tissues. This conservative estimate may serve to overestimate chromium concentrations in tissues. For this reason, the median BAFs presented in the same documents were used as alternative BAFs to estimate invertebrate and plant tissue concentrations as recommended in USEPA EcoSSL guidance (EPA 2005). It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of invertebrate tissue concentrations, but the likelihood of overestimation of risks is reduced.

### *Toxicity Reference Values*

For terrestrial plants, the summary of chromium toxicity in Efroymson et al. (1997a) places low confidence in the value because there are no primary reference data showing toxicity to plants and the basis for the NOEC ESL is not discussed in the document. The document simply notes that confidence in the values is low due to the small number of studies on which it was based. Efroymson et al. (1997a) also provides plant toxicity values from Turner and Rust (1971) that are based on growth effects on grown in loamy soils. No effects to plant growth were noted at 10 milligrams per kilogram (mg/kg) while shoot weight was reduced by 30 percent at chromium concentrations equal to 30 mg/kg. Uncertainty is high using the alternative values but reduced from the unspecified and unsupported 1 mg/kg value used as the ESL.

For terrestrial invertebrates, the ESL is based on survival effects to earthworms exposed to hexavalent chromium (chromium VI). Severe effects on survival were noted at 2 mg/kg chromium VI. The 0.4 mg/kg ESL was calculated by Efroymson et al. (1997b) by dividing be a safety factor of 5. There is some uncertainty in the chromium VI TRV since trivalent chromium (chromium III) is the most prevalent form of inorganic chromium found in soils (Kabata-Pendias 2002) and chromium VI was rarely detected when sampled for anywhere at RFETs. This introduces uncertainty into the TRV selection process as chromium VI is regarded as the more toxic form of chromium.

Efroymson et al. (1997b) also provide data for a lowest observed effect concentration (LOEC) concentration where growth to earthworms was reduced by 30% at 32.6 mg/kg of chromium III. The alternative chromium III LOEC provides a useful alternative estimate of toxicity based on a more applicable estimate of chromium III toxicity.

The NOAEL and LOAEL TRVs for birds were obtained from Sample et al. (1996). The mammalian TRV was based on effects from chromium VI while the bird TRV was based on effects from chromium III.

The NOAEL TRV for chromium VI represents a dose of at which no effects to the survival of ducks were noted. The LOAEL TRV represents a dose rate at which an a decrease in survivability was noted in the same study. No threshold TRV was calculated in the CRA Methodology and one is not identified here. Therefore, the threshold for chromium VI toxicity lies somewhere between the NOAEL and LOAEL but the actual intake rate is uncertain.

There is some uncertainty in the chromium VI TRV since chromium III is the most prevalent form of inorganic chromium found in soils (Kabata-Pendias 2002) and chromium VI was rarely detected when sampled for anywhere at RFETs. This introduces uncertainty into the TRV selection process as chromium VI is regarded as the more toxic form of chromium (IRIS, 2005). The bird TRVs are based on mortality effects in black ducks and are based on chromium II toxicity. These values are based on appropriate endpoints and uncertainty in them is considered low. No alternative TRVs were identified for chromium III and none were available for chromium VI.

NOAEL and LOAEL TRVs for chromium VI were available for estimating risk to mammals. Only a NOAEL TRV was available for assessing risks to mammals from exposure to chromium III. All of the mammalian TRVs were obtained from Sample et al. (1996) and relate to reproduction and mortaility endpoints. Both the chromium VI and chromium III TRVs were used in the default analysis. As discussed above for birds, the use of the chromium VI TRV is likely to overestimate risks. The chromium VI NOAEL is less than the chromium III NOAEL by three orders of magnitude for similar endpoints. Care should be taken when reviewing the HQs calculated using the chromium VI TRVs. Uncertainty is also introduced into the risk estimates due to the lack of a LOAEL TRV for chromium. Since both TRVs were based on acceptable endpoints, no alternative TRVs were identified.

***Background Risks***

Chromium was detected in Rocky Flats Environmental Technology Site (RFETS) background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the terrestrial plants, terrestrial invertebrates, mourning dove (herbivore and insectivore), American kestrel, deer mouse (insectivore), and Preble's meadow jumping mouse (PMJM) were calculated using both the UCL and UTL of background soils. NOAEL HQs greater than to 1 were calculated for terrestrial plants, terrestrial invertebrates, and mourning dove (insectivore) with both the upper confidence limit (UCL) and upper tolerance limit (UTL) exposure point concentrations (EPCs). NOAEL HQs for terrestrial plants equaled 17 using the UTL while those calculated for terrestrial invertebrates equaled 42. Both NOAEL and LOAEL HQs greater than 1 were calculated for the mourning dove (insectivore). The LOAEL HQ equaled 3 using the UTL EPC. No LOAEL TRVs were available for terrestrial plants or invertebrates. These results suggest that since potentially significant risks are not typically expected at normal background levels that risks using the default HQ calculations may be overpredicted. Site-specific background concentrations of chromium do not appear to be elevated as the maximum detected concentration in background surface soil samples equaled 16.9 mg/kg which is lower than the mean concentration of chromium in Colorado and bordering states as discussed in Attachment 3. These uncertainties should be considered in risk management decisions.

## 1.3 Copper

*Bioaccumulation Factors*

For the soil-to-plant, soil-to-invertebrate, and soil-to-small mammal BAFs, regression equations were used to estimate plant tissue concentrations. Confidence placed in these values is high; however, uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate tissue concentrations of copper to an unknown degree.

*Toxicity Reference Values*

The NOAEL and LOAEL TRVs for birds were obtained from PRC Environmental Management, Inc. (PRC) (1994). The PRC document reviewed the available effects database for avian effects from copper. The NOAEL TRV represents a dose of copper at which no growth, developmental, reproductive, or mortality effects were noted. The LOAEL TRV represents a dose rate at which an increase in the erosion of chicken gizzards was noted. The CRA Methodology noted that the nature of the effect predicted by the LOAEL TRV is not likely to cause significant effects on growth, reproduction, or survival in birds and, subsequently, calculated a threshold TRV. The threshold TRV represents an estimate of the point between the NOAEL and LOAEL TRVs where effects related to the LOAEL TRV may begin to occur. This point is uncertain and it is impossible to accurately estimate where the threshold for effects lies given the available data. Therefore, the calculation of the threshold TRV may overestimate or underestimate the calculated risks by a degree less than half of the difference between the NOAEL and LOAEL TRVs. In addition, the ability of the LOAEL TRV endpoint to predict effects to populations of avian receptors at RFETS under the assessment endpoints used in this CRA is uncertain. The effect that gizzard erosion in birds has on population-level endpoints is unclear, but risk estimations are likely to be conservative and over-predict risk. However, Sample et al. (1996), a CRA Methodology-approved TRV source, provides avian TRVs for growth and mortality endpoints to neonate chickens that are very similar to the LOAEL TRV from PRC (PRC LOAEL = 52.3 milligram per kilogram per receptor body weight per day (mg/kg/BW/day); Sample LOAEL = 61.7 mg/kg/BW/day). Because the two LOAEL values are similar, the uncertainty in the PRC LOAEL is reduced and no alternative TRVs are provided to calculate risk to the mourning dove receptors. The PRC value is considered to be protective of growth and mortality effects in birds. Although it may over-predict risks, the degree is likely to be small.

*Background Risks*

Copper was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the mourning dove (herbivore and insectivore) were calculated using both the UCL and UTL of background soils. No HQs greater than 1 were calculated for either receptor using the NOAEL, threshold or LOAEL TRVs. NOAEL HQs equal to 1 were calculated for the mourning dove (insectivore) with both the UCL and UTL EPCs. NOAEL HQs for the mourning dove (herbivore) equaled 0.7 for the UCL and UTL EPCs. These results indicate that HQs calculated in the risk estimation are not overly conservative in terms of predicting risk at natural background concentrations.

## 1.4 Manganese

*Bioaccumulation Factors*

There are several important uncertainties associated with the intake and HQ calculations for vertebrate receptors. Manganese has two types of bioaccumulation factors used in the intake calculations. For the *soil-to-invertebrate BAF*, a regression equation was used to estimate tissue concentrations. Confidence placed in this value is high; however, uncertainty is unavoidable when using even high quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate invertebrate tissue concentrations of manganese to an unknown degree.

The soil-to-plant and soil-to-small mammal BAFs used to estimate tissue concentrations are based on screening-level upper bound (90th percentile) BAFs presented in ORNL (1998) and Sample et al. (1998b). These values provide conservative estimates of uptake from soils to tissues. This conservative estimate may serve to overestimate manganese concentrations in plant and small mammal tissues. For this reason, the median BAFs presented in the same document were used as alternative BAFs to estimate tissue concentrations. It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of plant and small mammal tissue concentrations, but the likelihood of overestimation of risks is reduced. In addition, the conservative nature of the upper-bound soil-to-plant BAF directly affects the conservatisms in the soil-to-small mammal BAF that uses the both the soil-to-plant and soil-to-invertebrate BAFs in its calculation. It is unclear to what degree and direction that uncertainty can be estimated for the soil-to-small mammal BAF, but the uncertainty associated with the estimated small mammal tissue concentrations is high.

***Toxicity Reference Values***

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from PRC (1994), a CRA Methodology-approved source of TRVs. The LOAEL TRV represents an intake rate at which a decrease in testical weight in mice was noted. The NOAEL TRV was taken from the same study and represents an intake rate at which no effects on testicular weight was noted. No threshold TRV was identified in the CRA Methodology, so it is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV. In addition, no relationship appears to have been identified between decreased testicular weight to reductions in reproductive success. This introduces some uncertainty into the risk assessment. However, since the endpoint for the LOAEL TRV is based on potential reproductive effects, the uncertainty is likely to be limited. Risks predicted by the LOAEL TRV may be overestimated, but the degree of uncertainty is low.

***Background Risks***

Manganese was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to all receptors were calculated using both the UCL and UTL of background soils. NOAEL HQs greater than 1 were calculated for the mourning dove (herbivore and insectivore. NOAEL HQs equaled 5 and 4 respectively when calculated using the background UTL as the ECP. No HQs greater than 1 were calculated for any receptor using LOAEL TRVs. These results indicate that HQs calculated in the risk estimation are not overly conservative in terms of predicting risk at natural background concentrations.

## 1.5 Molybdenum

***Bioaccumulation Factors***

The soil-to-invertebrate BAF used to estimate invertebrate tissue concentrations for the deer mouse (insectivore) is based on a screening-level upper bound (90th percentile) BAF presented in Sample et al. (1998a). This value provides a conservative estimate of uptake from soils to invertebrate tissues. This conservative estimate may serve to overestimate molybdenum concentrations in invertebrate tissues. For this reason, the median BAF presented in the same document (Sample et al. 1998b) can be as an alternative BAF to estimate invertebrate tissue concentrations. It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of invertebrate tissue concentrations, but the likelihood of overestimation of risks is reduced.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from Sample et al. (1996), a CRA Methodology-approved source of TRVs. The LOAEL TRV represents an intake rate at which an increased incidence of runts in mouse litters was noted. No NOAEL TRV was available, so the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is unclear at which intake-rate the true NOAEL lies. However, this source of uncertainty is limited because the LOAEL TRV is of sufficient quality to assess risks and the LOAEL TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated, but the degree of uncertainty is low.

***Background Risk Calculations***

Molybdenum was not detected in background surface soils. Therefore, background risks were not calculated for molybdenum in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

## 1.6 Nickel

***Bioaccumulation Factors***

There are several important uncertainties associated with the intake and HQ calculations for vertebrate receptors. Nickel has two types of bioaccumulation factors used in the intake calculations. For the soil-to-plant and soil-to-small mammal BAFs, regression equations were used to estimate tissue concentrations. Confidence placed in these values is high; however, uncertainty is unavoidable when using even high quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate tissue concentrations of nickel to an unknown degree.

The soil-to-invertebrate BAF used to estimate invertebrate tissue concentrations is based on a screening-level upper bound (90th percentile) BAF presented in Sample et al. (1998a). This value provides a conservative estimate of uptake from soils to invertebrate tissues. This conservative estimate may serve to overestimate nickel concentrations in invertebrate tissues. For this reason, the median BAF presented in the same document (Sample et al. 1998b) can be used as an alternative BAF to estimate invertebrate tissue concentrations.

It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of invertebrate tissue concentrations, but the likelihood of overestimation of risks is reduced.

***Toxicity Reference Values***

Uncertainty is also present in the TRVs used in the default HQ calculations for nickel. The NOAEL-based ESL calculated for the deer mouse (insectivore) was equal to 0.431 mg/kg, a concentration less than all site-specific background samples (minimum background concentration = 3.8 mg/kg). The NOAEL TRV used to calculate the ESL was estimated from the LOAEL TRV in the CRA Methodology by dividing by a factor of 10. The LOAEL TRV for mammals (1.33 mg/kg/BW/day) is based on pup mortality in rats. Given that the LOAEL TRV is 10 times the NOAEL TRV, a back-calculated soil concentration using the LOAEL TRV equals 3.8 mg/kg. This concentration is equal to the minimum detected concentration of nickel in background soils and would be exceeded by 19 of the 20 site-specific background soil concentrations. Because risks to ecological receptors are not generally expected in background areas, this indicates that the default TRVs used to calculate risks for mammals in general, and the deer mouse (insectivore) specifically, are too conservative and risks are over-predicted when using these TRVs.

For avian receptors, there is also uncertainty in the quality of the TRVs selected in the CRA Methodology to predict population-level effects to birds at RFETS. The TRVs selected by PRC (1994) relate to the prediction of edema and swelling in leg and foot joints in mallard ducks. The CRA Methodology noted that the nature of the effect predicted by the LOAEL TRV is not likely to cause significant effects on growth, reproduction, or survival in birds and, subsequently, calculated a threshold TRV. The threshold TRV represents an estimate of the point between the NOAEL and LOAEL TRVs where effects related to the LOAEL TRV may begin to occur. This point is uncertain and it is impossible to accurately estimate where the threshold for effects lies. Therefore, the calculation of the threshold TRV may overestimate or underestimate the calculated risks by a degree less than half of the difference between the NOAEL and LOAEL TRVs. In addition, the ability of the LOAEL TRV endpoint to predict effects to populations of avian receptors at RFETS under the assessment endpoints used in this CRA is also uncertain. The effect that swelling of leg and toe joints in birds has on population-level endpoints is unclear and risk estimations are likely to be conservative and over-predict risks related to the assessment endpoints.

The CRA Methodology prescribed a hierarchy of TRV sources from which TRVs could be identified and used without modification. TRVs were selected first from EPA EcoSSL guidance (EPA 2003) from which no nickel TRVs were available. The second Tier TRV source was PRC (1994), from which the LOAEL TRV was obtained and the NOAEL TRV was estimated. Because this value appears to be overly-conservative, the third Tier TRV source (Sample et al. 1996) was reviewed for a usable TRV. Sample et al. (1996) presents TRVs for birds and mammals.

The use of these alternative risk calculations serves to provide an estimate of risk using a reasonable, yet reduced, level of conservatism for all receptors and a reduction of uncertainty (to an unknown extent) for the mourning dove (insectivore) receptor.

### *Background Risks*

Nickel was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the PMJM, deer mouse (insectivore and herbivore), coyote (generalist and insectivore), American kestrel, and mourning dove (insectivore) were calculated using both the UCL and UTL of background soils and default NOAEL, threshold (American kestrel and mourning dove only), and LOAEL TRVs.

NOAEL HQs greater or equal to 1 for all receptors were calculated using both the UCL and UTL background surface soil concentrations. NOAEL HQs ranged from 1 for the deer mouse (herbivore) to 27 for the PMJM. LOAEL HQs were less than 1 for the deer mouse (herbivore), mourning dove (insectivore) and both coyote receptors but greater than 1 for the PMJM (HQ = 3), and deer mouse (insectivore) (HQ = 3). These results suggest that since potentially significant risks are not typically expected at normal background levels that risks using the default HQ calculations may be over-predicted. Site-specific background concentrations of nickel do not appear to be elevated as the maximum detected concentration in background surface soil samples equaled 14.0 mg/kg which is lower than the mean concentration of chromium in Colorado and bordering states (18.8 mg/kg) as discussed in Attachment 3. These uncertainties should be considered in risk management decisions.

## 1.7 Silver

### *Plant Toxicity*

The summary of silver toxicity in Efroymson et al. (1997a) places low confidence in the value because there are no primary reference data showing toxicity to plants and the NOAEL ESL value is based on unspecified toxic effects. The only alternative TRV available in the literature was an ESL soil screening benchmark from EPA Region 5. Low confidence is also placed in the alternative values because no effects are specified. The uncertainty associated with the lack of toxicity data for terrestrial plants is high. It is unclear whether risks are overestimated or underestimated by using the default or alternative toxicity values but overestimation is the more likely scenario because both are termed screening levels and represent unclear effects.

### *Background Risk Calculations*

Silver was not detected in background surface soils. Therefore, background risks were not calculated for silver in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

## 1.8 Tin

### *Bioaccumulation Factors*

The primary source of uncertainty in the risk estimation for tin is in the estimation of tissue concentrations. No high-quality regression models or BAF data were available for any of the three soil-to-tissue pathways. As a result, plant tissue concentrations are estimated using a biotransfer factor from soil-to-plant tissue from Baes et al. (1984). The values presented in Baes et al. (1994) were the lowest tier for data quality in the CRA Methodology and represent the most uncertain BAF available. It is unclear whether the Baes et al. (1984) BAFs overestimate or underestimate uptake into plant tissues, and the magnitude of uncertainty is also unknown but could be high.

No data were available to estimate invertebrate concentrations from soil. As a result, a default value of 1 was used. This value assumes that the concentration in invertebrate tissues is equal to the surface soil concentration. There is a large degree of uncertainty in this assumption. Because tin is not expected to bioaccumulate in the food chain, invertebrate tissue concentrations are likely to be overestimated to an unknown degree using this BAF. The lack of quality soil-to-plant and soil-to-invertebrate BAFs directly affects the quality of the soil-to-small mammal BAF that uses the previous two values in its calculation. Compounding the uncertainty for this BAF is a food-to-tissue BAF, again from Baes et al. (1984). It is unclear to what degree and direction that uncertainty can be estimated for the soil-to-small mammal BAF, but the uncertainty associated with the estimated small mammal tissue concentrations is high.

### *Toxicity Reference Values*

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from PRC (1994). The selected NOAEL TRV is protective of systemic effects in mice. These effects are not associated with the assessment endpoints for mammalian receptors at RFETS and, therefore, are overly conservative for use in the CRA. However, the LOAEL TRV selected by PRC (1994) is from a proper endpoint for use in the CRA and is described by PRC (1994) as predictive of a mid-range of effects less than mortality. Therefore, while the uncertainty related to the NOAEL TRV for mammals is high, the uncertainty for the LOAEL TRV is considerably lower. For this reason, no alternative TRVs are recommended in the uncertainty analysis.

For avian receptors, the TRVs selected for use in the CRA were also obtained from PRC (1994) and represent a paired NOAEL and LOAEL from a study on Japanese quail reproduction. No effects on reproduction were noted at the NOAEL, while reduced reproduction was noted at the LOAEL intake rate. Because the endpoints represented by the TRVs are appropriate for use in the CRA, the uncertainty in the avian TRVs for tin is considered to be low.

### *Background Risk Calculations*

Tin was not detected in background surface soils, therefore, background risks were not calculated for tin in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

## 1.9 Uranium

### *Plant Toxicity*

The summary of plant toxicity in Efroymson et al. (1997a) places low confidence in the value because it is based on only one study that showed a reduction in root weight for Swiss chard in sandy soil. The only alternative TRV available in the literature was an alternate LOEC ESL. Low confidence is also placed on this alternative value because no effects are specified. The uncertainty associated with the lack of toxicity data for terrestrial plants is high. It is unclear whether risks are overestimated or underestimated by using the default or alternative toxicity values but overestimation is the more likely scenario because both are termed screening levels and represent unclear effects.

### *Background Risk Calculations*

Uranium was not detected in background surface soils. Therefore, background risks were not calculated for uranium in Appendix A, Volume 2, Attachment 9 of the RI/FS Report

## 1.10 Vanadium

### *Plant Toxicity*

The summary of vanadium toxicity in Efroymson et al. (1997a) places low confidence in the value because there are no primary reference data showing toxicity to plants and the NOAEL ESL value is based on unspecified toxic effects. An alternative LOEC TRV was also available as cited in Efroymson et al. (1997a) and was based again on unspecified effects of vanadium added to soil at a concentration of 50 mg/kg. No information regarding the baseline concentration of vanadium in the soil was available. Low confidence is also placed in the alternative values. The uncertainty associated with the lack of toxicity data for terrestrial plants is high. It is unclear whether risks are overestimated or underestimated by using the default or alternative toxicity values, but overestimation at the screening ESL is the more likely scenario. The alternate LOEC may reduce that uncertainty to an unknown degree.

### *Bioaccumulation Factors*

The soil-to-invertebrate and soil-to-plant BAFs used to estimate invertebrate tissue concentrations are both based on screening-level upper-bound (90th percentile) BAFs presented in Sample et al. (1998a) and ORNL (1998). These values provide conservative estimates of uptake from soils to invertebrate and plant tissues. This conservative estimate may serve to overestimate vanadium concentrations in tissues. For this reason, the median BAFs presented in the same documents were used as alternative BAFs to estimate invertebrate and plant tissue concentrations. It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of invertebrate tissue concentrations, but the likelihood of overestimation of risks is reduced.

### *Toxicity Reference Values*

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from Sample et al. (1996), a CRA Methodology-approved source of TRVs. The LOAEL TRV represents an intake rate at which a decrease in reproductive success in mice was noted. No NOAEL TRV was available, so the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is also unclear at which intake-rate the true NOAEL lies. However, this source of uncertainty is limited because the LOAEL TRV is of sufficient quality to assess risks and the LOAEL TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated, but the degree of uncertainty is low.

***Background Risks***

Vanadium was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the terrestrial plant, PMJM and deer mouse (insectivore) were calculated using both the UCL and UTL of background soils and default NOAEL and LOAEL TRVs.

HQs equal to 23 and 15 were calculated for the terrestrial plant receptor using UTL and UCL EPCs respectively. Because no exposure modeling is conducted for terrestrial plants, this indicates that the ESL is likely to be over-conservative when assessing risks to plant populations. This conservatism should be considered when viewing the results of the risk characterization for vanadium.

NOAEL HQs greater or equal to 1 were calculated using both the UCL and UTL background surface soil concentrations for the PMJM and deer mouse (insectivore) receptors. NOAEL HQs ranged from 1 for both receptors using the UCL to 2 for both receptors using the UTL EPCs. LOAEL HQs were less than 1 for both receptors. These results indicate that HQs calculated in the risk estimation are not overly conservative in terms of predicting risk at natural background concentrations.

## 1.11 Zinc

***Bioaccumulation Factors***

For the soil-to-plant, soil-to-invertebrate, and soil-to-small mammal BAFs, regression equations were used to estimate plant tissue concentrations. Confidence placed in these values is high. Uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. However, in cases without available measurements of tissue concentrations, regression-based models are the best available predictor of tissue concentrations. The regression-based BAFs may overestimate or underestimate tissue concentrations of zinc to an unknown degree.

### *Toxicity Reference Values*

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from PRC (1994), a CRA Methodology-approved source of TRVs. The LOAEL TRV represents an intake rate at which an increased incidence of fetal developmental effects in rats. No NOAEL TRV was available, so the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is unclear at which intake-rate the true NOAEL lies. However, this source of uncertainty is limited because the LOAEL TRV is of sufficient quality to assess risks and the LOAEL TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated but the degree of uncertainty is low.

### *Background Risks*

Zinc was detected in RFETS background surface soils. Since risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the PMJM receptor were calculated using both the UCL and UTL of background soils and default NOAEL and LOAEL TRVs.

NOAEL HQs greater than 1 for were calculated using both the UCL and UTL background surface soil concentrations for the PMJM receptor. LOAEL HQs were less than 1 for the PMJM receptor. These results indicate that HQs calculated in the risk estimation are not overly conservative in terms of predicting risk at natural background concentrations when the LOAEL TRV is used. The NOAEL TRV may be somewhat over-conservative.

## 1.12 Bis(2-ethylhexyl)phthalate

### *Bioaccumulation Factors*

Both invertebrate and small mammal tissue concentrations for bis(2-ethylhexyl)phthalate were estimated using uptake models based on the log Kow of bis(2-ehtylhexyl)phthalate. As cited in the CRA Methodology, if organic ECOIs with no empirically calculated BAFs available in the first two sources, log Kow equations are used (as presented and modified in the EPA EcoSSL [EPA 2003a]). These values are more uncertain than empirically based BAFs and are likely to overestimate tissue concentrations to an unknown degree. This uncertainty is compounded in the soil-to-small mammal BAF that uses both the soil-to-invertebrate and soil-to-plant (also log Kow-based) BAFs to estimate the diet of the small mammal. A second model is then used to estimate the amount of ECOI transferred from prey food to prey tissues. This compounded uncertainty may overestimate the concentrations of bis(2-ethylhexyl) phthalate by an even larger degree than was noted for the soil-to-invertebrate pathway.

*Toxicity Reference Values*

Appendix B of the CRA Methodology presents only a NOAEL TRV for avian effects from bis(2-ethylhexyl)phthalate. No reproductive effects were noted in ring doves at a dose of 1.1 mg/kg/BW/day. Because no effects were noted at the highest dose level in the study presented in the CRA Methodology, EPA's Ecotox database was searched for an alternative study. The following study was identified as applicable for use in the risk characterization.

European starlings were fed a concentration of 0, 25, and 250-mg/kg bis(2ethylhexyl)phthalate via capsules daily (O'Shea and Stafford 1980). Significant increases in body weight were noted at the 25-mg/kg level, which was identified as the LOAEL. While the effects of increased body weight on the health of bird populations is questionable, the resulting TRV is used as the LOAEL for the risk characterization. No food ingestion rates or body weight for the animals used in the study were provided in the Ecotox database, so they were estimated. The body weight and ingestion rate for the American robin (EPA 1993) were used as surrogates (body weight = 0.077 kg; food ingestion rate = 1.52 mg/kg/BW/day). Converting the 25-mg/kg concentration to a dose resulted in a LOAEL TRV equal to 214 mg/kg. Given the questionable endpoint used in the LOAEL study, the risks calculated using the LOAEL are likely to be overestimated to an unknown degree. The uncertainty associated with the TRVs used to assess risk to avian receptors from bis(2 ethylhexyl)phthalate is high.

*Background Risk Calculations*

Bis(2-ethylhexyl)phthalate was not analyzed for in background surface soils. Therefore, background risks were not calculated for bis(2-ethylhexyl)phthalate in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

## 1.13 Di-n-butylphthalate

*Bioaccumulation Factors*

Both invertebrate and small mammal tissue concentrations for di-n-butylphthalate were estimated using uptake models based on its log Kow. As cited in the CRA Methodology, if organic ECOIs with no empirically calculated BAFs available in the first two sources, log Kow equations are used (as presented and modified in the EPA EcoSSL [EPA 2003a]). These values are more uncertain than empirically based BAFs and are likely to overestimate tissue concentrations to an unknown degree. This uncertainty is compounded in the soil-to-small mammal BAF, which uses both the soil-to-invertebrate and soil-to-plant (also log Kow-based) BAFs to estimate the diet of the small mammal. A second model is the used to estimate the amount of ECOI transferred from prey food to prey tissues. This compounded uncertainty may overestimate the concentrations of di-n-butylphthalate by a larger degree than noted for the soil-to-invertebrate pathway.

### *Toxicity Reference Values*

The TRV used was obtained from Sample et al. (1996) from a study of reproductive effects in ring doves. Changes in eggshell thickness were noted at the LOAEL intake rate. No NOAEL TRV was available, so the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is unclear at which intake-rate the true NOAEL lies. However, this source of uncertainty is limited since LOAEL TRV is of sufficient quality to assess risks and the LOAEL TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated, but the degree of uncertainty is low.

### *Background Risk Calculations*

Di-n-butylphthalate was not analyzed for in background surface soils. Therefore, background risks were not calculated for di-n-butylphthalate in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

## 1.14 Dioxin (Total)

### *Bioaccumulation Factors*

The soil-to-plant BAF used to estimate tissue concentrations are based on screening-level upper bound (90th percentile) BAFs presented in ORNL (1998) and Sample et al. (1998b). This BAF provides a conservative estimate of uptake from soils to plant tissue. For the soil-to-invertebrate and soil-to-small mammal BAFs, regression equations were used to estimate invertebrate and small mammal tissue concentrations, respectively. Confidence placed in these values is high. Uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. However, in cases without available measurements of tissue concentrations, regression-based models are the best available predictor of tissue concentrations. The regression-based BAFs may overestimate or underestimate tissue concentrations of total PCBs to an unknown degree.

### *Toxicity Reference Values*

For avian receptors, TRVs were obtained from the database of TRVs from Sample et al. (1996). The LOAEL TRV was derived from a study of reproductive effects in pheasants. At the LOAEL intake rate, a significant decrease in egg production and hatchability was noted. The NOAEL intake rate suggested that there was no effect on pheasant egg production and hatchability. Because the original study was not reviewed and not enough information is presented in Sample et al. (1996) to meet threshold criterion, no threshold TRV has been calculated for birds. The estimation of the NOAEL TRV from a LOAEL TRV introduces uncertainty in the NOAEL TRV. However, because the LOAEL TRV is based on endpoints appropriate for use by receptors in the UWOEU, the uncertainty associated with the TRVs is considered low. The TRVs may overestimate or underestimate risk to an unknown degree.

For mammalian receptors, TRVs were also obtained from the database of TRVs from Sample et al. (1996). The LOAEL TRV was derived from a study of reproductive effects in rats. At the LOAEL intake rate, a significant decrease in fertility and neonatal survival was noted. The NOAEL intake rate suggests that there were no reproductive effects on rats at that concentration. Because the original study was not reviewed and not enough information is presented in Sample et al. (1996) to meet threshold criterion, no threshold TRV has been calculated for mammals. The estimation of the NOAEL TRV from a LOAEL TRV introduces uncertainty in the NOAEL TRV. However, because the LOAEL TRV is based on endpoints appropriate for use by receptors in the UWOEU, the uncertainty associated with the TRVs is considered low. The TRVs may overestimate or underestimate risk to an unknown degree.

***Background Risk Calculations***

Dioxins were not analyzed for in background surface soils. Therefore, background risks were not calculated for dioxin in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

## 1.15 PCB (Total)

***Bioaccumulation Factors***

For the soil-to-plant, soil-to-invertebrate, and soil-to-small mammal BAFs, regression equations were used to estimate plant tissue concentrations. Confidence placed in these values is high. Uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. However, in cases without available measurements of tissue concentrations, regression-based models are the best available predictor of tissue concentrations. The regression-based BAFs may overestimate or underestimate tissue concentrations of total PCBs to an unknown degree.

A higher level of uncertainty is associated with the log Kow-based soil-to-small mammal BAF, which uses both the soil-to-invertebrate and soil-to-plant (also log Kow-based) BAFs to estimate the diet of the small mammal. The food-to-tissue model used in the second step of the estimation of total PCB concentrations in small mammals is used to estimate the amount of PCBs transferred from prey food to prey tissues. This compounded uncertainty may overestimate the concentrations of total PCBs by a larger degree than noted for the soil-to-invertebrate pathway.

***Toxicity Reference Values***

For avian receptors, total PCB TRVs were obtained from the database of TRVs from PRC (1994). The LOAEL TRV was derived from a study of reproductive effects in chickens. At the LOAEL intake rate, a significant decrease in egg hatchability was noted. The NOAEL TRV is set at an intake rate that showed potential effects on egg hatchability in chickens and then reduced by one-tenth to convert the concentration to a NOAEL. Because the NOAEL and LOAEL TRVs came from two different studies with different methods and the NOAEL TRV was estimated from an effect-based TRV, no threshold TRV has been calculated for birds. The estimation of the NOAEL TRV from a LOAEL TRV introduces uncertainty in the NOAEL TRV. However, because the LOAEL TRV is based on endpoints appropriate for use by receptors in the UWOEU, the uncertainty associated with the TRVs is considered low. The TRVs may overestimate or underestimate risk to an unknown degree.

***Background Risk Calculations***

PCBs were not analyzed for in background surface soils. Therefore, background risks were not calculated for PCB in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

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# COMPREHENSIVE RISK ASSESSMENT

## UPPER WOMAN DRAINAGE EXPOSURE UNIT

## VOLUME 10: ATTACHMENT 6

## CRA Analytical Data Set